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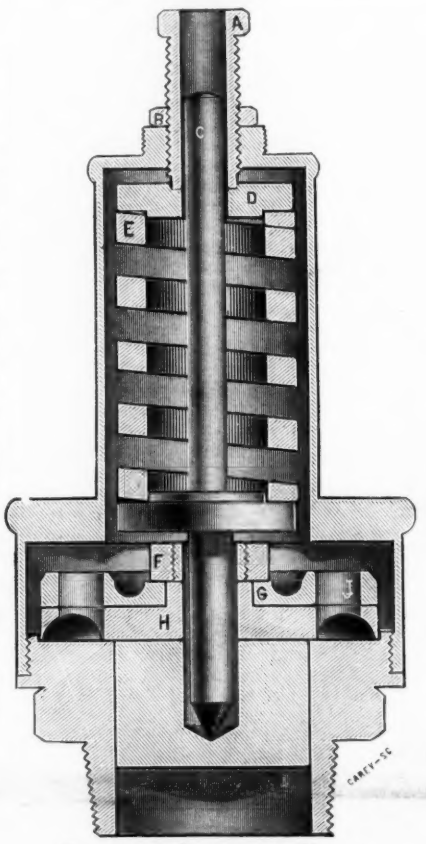
The American Pop Safety Valve.

We present with this, engravings representing several forms of a new spring loaded safety valve, the invention of W. E. Pearson, and manufactured by the American Steam Gauge Company, Boston, Mass. These valves are of the type in which the steam is made to act against an increased area after it passes the ground joint, the effect of which is to overcome the resistance of the spring and raise the valve a considerable distance from the seat, permitting free escape of steam beyond the capacity of the boiler to generate, and doing away with danger from pressure higher than that at which the valve is set to blow.

From the engraving representing a sectional view of locomotive valve, and from Fig. 1, the construction may be studied. It will be seen that the valve proper, *H*, is provided with a secondary head, *G*. Through the head of the valve proper, and into chamber *P*, a series of holes are drilled at an angle of 90° with the seat, and through the secondary head a series, *J*, are drilled at an angle of 55° with those through the head of the valve. This secondary head is a loose fit on the upper projecting part of the valve, being held from lifting away from it by the nut *F*. When the valve is at rest, the head, *G*, is held by means of the spring, *S*, in such a position with reference to the head of the valve that only small portions of the two series of holes previously referred to coincide, as clearly shown in Fig. 1.



SECTION OF LOCOMOTIVE VALVE.

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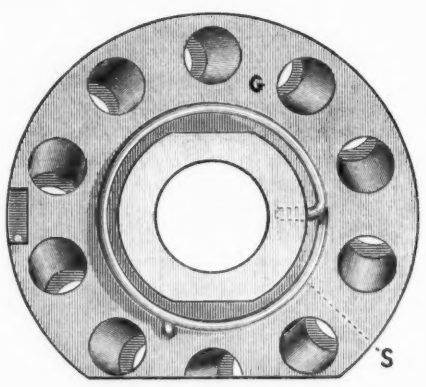


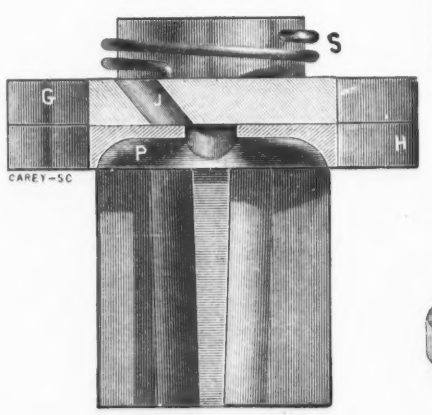
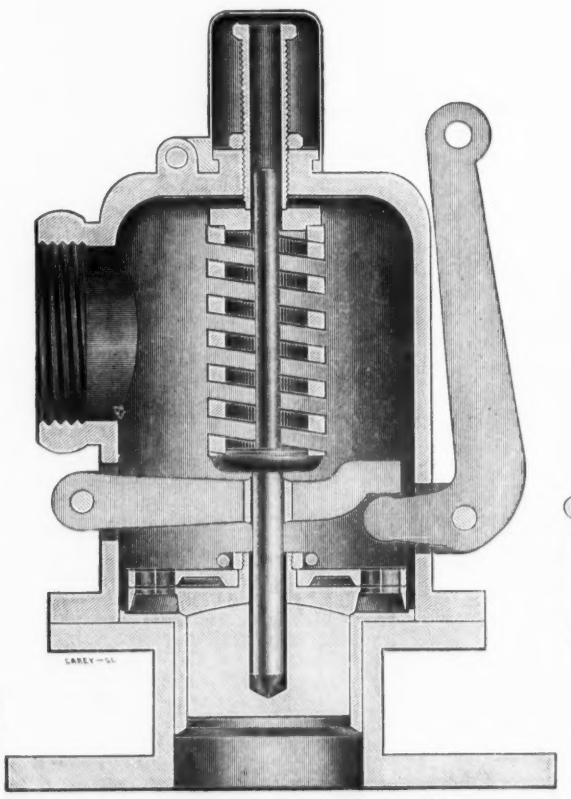
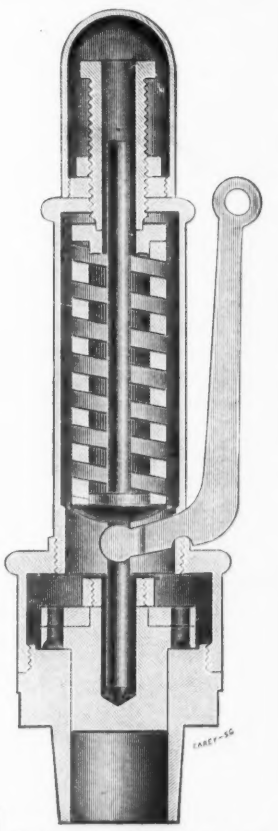


FIG. 1.

STATIONARY AND MARINE VALVE.



SECTION OF STATIONARY AND MARINE VALVE.



SECTION OF PORTABLE AND FIRE ENGINE VALVE.

In operation, when the valve starts from its seat the escaping steam acts against the exposed surface of the head, lifting the valve from its seat so as to give a free outlet for steam, overcoming the increasing tension of spring, *E*, through having an area to act upon about double that upon which it acts before the valve starts from its seat. But most of the escaping steam must find its way out through the two series of holes mentioned, and the holes in the upper head being at an angle with those in the lower one, the inpinging steam operates in a way that will be clearly understood to move the upper head around till the two series of holes coincide altogether. The effect of this is to decrease the effective area against which the steam has operated to open the valve, and this permits spring *E* to bring the valve to its seat without serious decrease of boiler pressure. The end aimed at by the peculiar construction noted is to bring about a prompt opening of valve at exactly the desired pressure, a high lift to quickly relieve the pressure, and the seating of the valve as soon as the pressure is slightly reduced. When the valve closes, the spring, *S*, returns the head, *G*, to the position shown in Fig. 1.

The spring *E* is adjusted to hold the required pressure by means of the nut *A* which is locked by the check nut *B*. *D* is a follower which holds the top of the spring in position in a manner made plain in the engraving.

The levers, as will be seen, can be operated to raise the valves only, and not to hold them down. They are so arranged that when not being used they are not in contact with any of the moving parts, and hence cause no friction on any of the parts of the valve or attachments.

These valves are made of a special anti-corrosive steam metal. They are furnished either with or without lock-up attachments, as desired.

Scraps—No. 4.

BY J. G. TRAMIS.

It is a common remark that there is too much ignorance in the world, which is probably true. It is also a common remark that the people are not well enough educated; that, too, is probably true, provided we give the correct definition to the word educated. According to the prevailing idea, the graduate of a college where the classical course of study is pursued is educated; and one who is favored only with a half dozen winters in a country school, but who has by study, observation, and experience, acquired a large collection of facts in regard to agriculture, mechanics, law, politics, and business, is not educated. In view of this meaning of the word, is it true that there are not enough educated people in the world?

In ordinary times an advertisement in one

of the daily papers for some one to fill a position where the above kind of education is the requirement, although the reward be a starvation salary, is responded to by hundreds. Let the demand be for a competent builder, and few will respond. This would look as if there were plenty of educated people in the world, but that a good many have been educated in the wrong direction. A good deal of this can be corrected by the schools and colleges, and when it is done it will likely be done by the schools and colleges forcing it upon the community, rather than by the community demanding it of the schools and colleges.

The man of moderate means, finding that by hard work he cannot leave a fortune to his children, comes to the praiseworthy determination that they shall have an education, and so they are in turn ground through the high school and college mill. when three out of the five may be as unfitted to profit by the instruction they receive as the other two are unfitted to make bankers or mechanics. Under the above conditions, the children are fortunate if the college or university be a large one, in which a variety of courses is available, as there is then a greater chance of drifting into a field more nearly approaching that for which nature has fitted them.

In the wide range in which the various colleges strive to give instruction in both classical and technical studies, there are many difficulties to contend with, one prominent one being to get the proper professors and instructors. The rules which govern in the selection of professors in the classical branches are not applicable to the choosing of professors in technical branches, or especially in branches requiring industrial instruction. A trustee or college president may ascertain from a professor of Greek whether one of his students is able to teach the same subject to another, who, in turn, may be able to teach to another. But the instructor in practical work must himself be a practical man, and there is no one to tell whether he can teach what he knows until he tries it. It is in this that the stupidity of the old system shows itself. It is the custom to find out whether a man can teach by looking at his diploma, or by asking some one, instead of putting him on trial, and then ignore the only source from which it is possible to ascertain whether he is a success or not; that is, consulting his students.* And so, not finding out, they allow the "figurehead" to keep his position until the practical branch becomes a laughing stock to the outside community.

If one were to follow up the history of the graduates of some, if not all, of our colleges, and note the proportion of failures (that is, the number of graduates who never make any use of their costly education) to those who are successful, he would find it such as in any other investment would be a lamentable failure. While this is not true in many cases, in others the returns given, owing to incompetent or indifferent instruction, is so disproportionate to the cost imposed on the student, that any Grand Jury would grant a true bill for swindling.

It is a common remark that a large proportion of crime in the country is due to the ignorance of the people, which is probably true if we give the right definition to the word ignorance; but the ignorance is not that represented by a lack of schooling, but by a lack of the knowledge which enables people to earn an honest living. Because the records of the prisons show a large percentage of the convicts to be devoid of higher education, it is no proof that the want of intellectual training is the cause of crime, or that, if all had the benefit of a college education, there would be no crime. The higher education has little influence in the prevention of crime, but in the hands of the criminal it is a powerful agent, aiding him to escape punishment. The natural criminal, having the advantage of an education, believes himself better able to evade detection, and seldom overestimates the favorable influence his position will exert against his conviction and punishment. Searching the prison records may prove many things, but none more conclusively than that the percentage of those who have been taught to earn their living, in proportion to the number from which they are drawn, is gratifyingly small.

The doctrine had better be preached and understood that one of the best ways to prevent crime is to teach mankind how to earn an honest living.

It is a common remark that the final success of our republican institutions depends upon the education of the masses, and yet it is hard to see wherein the more intelligent agree any better about government policy than the loungers at the corner grocery; and so, very likely, it will be as well to trust the matter to the good sense of an industrious people.

* It is a fundamental principle in colleges that the opinion of the students is never to be considered, except when in approval.

Fifty Miles on a Traction Engine in England.

The traction engine is not very well known in this country. It is designed to travel over wagon roads where there are no very steep hills. The following story of an experience with one of them is related by "J. G." in *Calvert's Mechanics' Almanac* for 1885:

In the early part of September 18—, a journey was made from a small engineering works in the Midland Counties (in which I was at that time an apprentice) to an almost unknown village lying about fifty miles south-east.

I had just been for a tour in Devon and Cornwall, and on my return found a traction engine nearly ready to leave the shops, one in which I felt an especial interest, having fitted up the cylinder and helped on it in its earlier stages of manufacture. I obtained permission to go with it to its destination. We started on Friday morning, and a first-class man, who was thoroughly versed in the manufacture, driving, and management of engines was appointed driver, myself to steer, and a faithful old servant of the firm preceded us with the usual red flag.

We started at 4.30 A. M. in good spirits, and steamed out of the yard at about five miles per hour. Being my first ride (for any long distance) on a traction engine, the terrific jarring which my whole system received was most painful; only those who have practically experienced it can have the remotest idea of it. The roads were rough, which made it worse than it otherwise would have been. We stopped after running about four miles to take in water, which we obtained in buckets from a pond by the road side, as this engine was not fitted with the usual water-lifter. This process is most unpleasant and slow. A few miles further we stopped to take in water, after which we started for the small market town, a distance of about ten miles, where we arrived about 1 P. M., after various stoppages for water, coal, etc. During this last run we noticed the exhaust seemed rather pinched, and, drawing the engine into a quiet nook by the road-side, we removed the steam-chest cover and found the cause; also that a new valve was required, which we telegraphed for, to be sent immediately to L. B station, which we should pass the following day. This delayed us so much that we were obliged to hasten on with all possible speed in order to arrive before dark at our first night's destination, but, owing to a slight mishap, to which a new engine is always liable, darkness overtook us when about three or four miles from there. However, we managed remarkably well by the aid of our lamps. The first thing on arrival was to find a suitable place to put up. We found an inn with a large yard attached, into which we ran, but the day's work was not done until it was wiped down and oiled, the tank and coal bunker filled, and finally covered over with a tarpaulin. The inn accommodation was far from being comfortable, and our dirty and oily attire afforded us little pleasure during the night.

At half-past three on Saturday morning we made preparations for another day's run. We moved about briskly to keep ourselves warm, as the morning air was bitterly cold. The first part of our journey was through some very fine scenery, which I believe stands unequaled in the Midland Counties. Just as the church clock chimed eight, we reached a large village, where we stopped for breakfast, and also to take in a full supply of coal and water. Again resuming our journey, we came to the foot of a moderately steep hill, where a rather amusing incident occurred with an ancient rustic, who attempted to stop us with outstretched arms in the middle of the road, but who soon evidently thought discretion the better part of valor, as he quickly hobbled out of the way when the engine approached him, and shouted at the top of his voice, "Yer —— fools, yew'l ne'er git hup that 'ill; 'underds the likes o' yew are bin beaten hat it long afore yew was born." However, our friend was slightly mistaken for once, as the engine mounted it without the slightest trouble, with its fast gear in, and the steam pressure considerably below that which the safety valves would permit.

At noon we arrived at the old-fashioned town, where the new valve awaited us, which was soon fitted in its place. The latter part of our journey was one of continued misfortune. The rain began to fall heavily and the wind to blow very hard, making our position very uncomfortable. In passing through a small village, one of our driving wheels suddenly sank deep in the road with a crash; a drain pipe had given way beneath the great weight. With one desperate effort we succeeded in getting out of the hole and proceeded on our way, leaving the ratepayers to repair the damage. Intense darkness soon overtook us, and the rain was still falling in torrents. To add to our troubles, we had to take a strange road, through a forest; but while stopping for water we came across a man thoroughly acquainted with the district and accustomed to engine-driving, who volunteered for a small sum to pilot us through, which offer we gladly accepted. Either he had been indulging in too much beer or was not accustomed to our style of engine, for he soon got into such a terrible muddle that we were obliged to resume our former posts, Jim Keen and the man, each carrying a lamp close to our driving wheels, for the road was extremely narrow, rough and dangerous, and had not been improved by recent timber-carting. Thus, under great difficulties, we managed to slowly creep along, but it was a most perilous time, for there was a deep dyke on either side of us. It would have been bad enough in the day-time, but it was infinitely worse in the pitch darkness. Instead of matters improving, they became worse than ever. Our water tank was empty, and, after going as far as we dare with what was in the boiler, we backed the engine, with the driving wheels partly down the side of the dyke, in order to keep the fire-box low and covered with water. We all went in search, and at last found a very shallow pond, in which we had to wade up to our knees in mud and water before we could dip the buckets in, forty or fifty of which had to be carried nearly two hundred yards to the engine before we could make a start. After another mile had been covered, a sharp turn in the road revealed a few straggling lights, the street lamps of C., our destination. All our difficulties were not over yet. We found, through the frightful speed the engine made, that we were going down a precipitous hill. Steam was immediately shut off and the brake applied, but still our light-bearers ahead had to run hard to keep up, and frantically shouted, "Stop! Stop!" Carter was pulling with all his might at the brake, and I was doing my utmost at the steering wheel to keep to the road, breathlessly expecting every instant to be shot headlong from the foot-plate. After an awful suspense, the bottom of the hill was safely reached. The whole time of coming down could not have occupied many minutes, but every minute seemed an hour. After stopping a few minutes, we walked back a short distance, and found by our track that we had had a hairbreadth escape of going over the edge of the steep embankment, which, if it had occurred, we should, in all probability, have never survived to tell the tale.

Twenty minutes after our destination was reached, but we were too tired and exhausted to wipe the engine down then, so simply covered it up, and, drenched to the skin, we wended our way to the George Inn. The landlord was just retiring to bed—half-past eleven—and very reluctantly came down to attend to our wants. He stoutly refused us a fire, but promised to have our clothes dried early next morning, and we had to remain in bed until they were brought to us. Early on Monday we set to work and thoroughly cleaned the engine down, and well it needed it. After delivering it, all safe and sound, to the purchaser, to whom it gave more than satisfaction, we returned home by train, sincerely hoping it would never fall to our lot to have another similar fifty miles on a traction engine.

We have received a letter from the Washburn Machine Shop, Worcester, Mass., saying that the emery wheel grinders which we illustrated three weeks ago were designed by M. P. Higgins, superintendent of that shop. The machines are being successfully introduced by F. B. Norton, of Worcester, although they were first brought out and placed upon the market under the name of the manufacturers, the Washburn Machine Shop. Mr. Norton now controls the sale of the machines.

Mr. M. N. Forney is designing a new form of locomotive intended for fast running. Mr. Forney's suburban locomotive has been so successful that we are encouraged to believe that his idea of the combinations needed to produce a locomotive capable of maintaining high speed efficiently and economically are likely to result in a successful engine.

The First European Thimble.

A bi-centenary of a curious kind has recently been celebrated at Amsterdam, being no less than the celebration of the invention of the thimble. It is just two centuries since last October that the first European thimble was made by Nicholas van Benschoten, a young goldsmith, who devised the article for the protection of the finger of his lady love, Mme. van Rensselaer, for thimbles, like many greater things, owe their origin to Dan Cupid. The English were the first to make thimbles on a large scale; but long before either Dutch or English thought of thimbles Chinese ladies were thimbled when they worked at their grand embroidery. The Chinese thimbles bore—and bear to this day—the form of a lovely lotos flower. There is no such poetry of shape in the Western finger hat.—*Pall Mall Gazette.*

Imprisoned in a Safe.

Most of people who are familiar with English romance know the Christmas-time story of the baron's lovely daughter who in a game of hide and seek hid herself in an old oaken chest which closed with a snap lock and imprisoned the maiden in a living tomb. A modern and somewhat unromantic version of the incident happened lately in Dundee, Scotland. A machinist was doing some repairs inside of a large safe when the door swung shut and the lock closed with a snap. None of the people around knew the combination and none of the locksmiths round could open the lock. Finally they had to send to England to the makers of the safe for a man to open it, and the machinist was imprisoned three days before the makers' man got round and released him.

Hammer and Grindstone.

BY JAMES F. HOBART.

Nearly every machinist in the United States has tried his hand at making a hammer. It is about the first piece of "government work" that a cub tackles. If he is satisfied with turning one from a bar of steel, finishing up round and "eight square," or octagon, he gets along pretty well except with the eye, which is apt to be drilled a little skewing. If Jack tries to forge a hammer, he gets himself into business at once. He takes a chunk of $1\frac{1}{2}''$ octagon steel, and punches the eye. The next time he makes a hammer he will drill a $\frac{1}{2}''$ hole, and swage it to suit. When the hole is punched and swaged, he finds it needs upsetting a little; so, with the last swage in the hole, he shortens up the thing about $\frac{3}{4}''$. This is where he makes his first mistake. You can work good tool steel, or machinery steel, either, as much as you please; draw, bend, or swage it; but the very first time you upset a piece of it, you must look out for checks and fire cracks.

Cold chisels, drills, and lathe tools work just the same way. Don't ever upset a chisel to get a square point. If the corners are rounding after drawing out, cut off the rounding part. Upset until square, and it won't stand ten blows of the hammer.

When our chap got his hammer done, he found a nice row of cracks all around the outside, making it look like a big sunflower. When the hammer was forged, Tom filed up the "eight square" parts, turned off the round, and went down stairs to temper it. Taking a good, cherry heat, Tom cooled off the hammer in the forge tub. Sam had been forging a big ring for hooping the hub of a pulley that was to be bored pretty large, and the water in the tub was hot as the hand could be borne in. When the hammer came out, Tom rubbed it on the floor to brighten the face, and shined up the sides with an emery stick. The temper began to run, and Tom began to try the hardness with an old

file. Down came the temper, grey, light straw blue, and purple. When the straw colors got along, Tom thought the file took hold about right, and cooled off the hammer. What a nice color it had! just that blue-straw tint that worked so well with that quality of steel!

Tom happened to try the file upon the middle of the hammer face, and found it soft! About as soft as iron. Tom scratched his head a few minutes, and then took that hammer back to the smith shop. He looked at the hammer, and then at the steaming water tub. He took another heat on that hammer, and went outdoors to a big icicle that hung from a gutter in the roof. He held the center of the hammer face against the icicle until it was cold. The fire cracks didn't show half as bad as they did. It didn't shrink any in the center before, and those fire cracks were all open. Tom says he don't calculate to upset the next hammer head he makes, but he is going to finish up this one as long as he has commenced it, and next time he will leave the centers on till he gets the hammer polished.

Tom goes for the grindstone to grind up the octagon places a little. That stone was one of the "independent" concerns. They are pretty apt to be found in the machine shop, and out of it, too. Sometimes that stone would be nice and smooth, but the next day it would look like a muddy road in a cold snap. Tom could not find a sharp corner on that stone, but a corner he must have. He hates to true a grindstone. Who don't? I never would true one if we could get along without it, and I figured out long ago that a grindstone without a truing device permanently attached to it was a case of poor judgment on the part of the owner of the stone.

That stone was 30″ in diameter, 8″ face, and if the face were unrolled on the floor, it would look like a plan of the Rocky Mountains. Tom crawled under a bench, and when he backed out he had a piece of ¼″ gas pipe about three feet long in his hand. He laid a heavy iron on the frame for a rest, turned on the water and cut a groove in the stone close to one edge. As fast as the pipe ground off, Tom revolved it in his hand. The section of the iron being thin, it always kept comparatively sharp. Tom cut grooves across the stone, about ¾″ apart. It did not cut quite as fast with water on the stone, but the dust all went with the water. When a dry stone is trued in a shop, the boys are apt to be heard from in new adjectives.

After Tom got the grooves just deep enough to strike all around the stone; he threw off the belt and stopped the stone. The grooves were an inch deep on one side, and just touched the face on the other side. Ten minutes with hammer and cold chisel made that part of the shop look like a stone-yard. Tom started up the stone again, smoothed up the chipped places with his gas pipe, and ground his new hammer.

Keep a truing device upon your grindstone frame. When you see the stone run out of true a trifle, give a turn to the screw and the stone will be true in no time.

It is about as much work to pick out a good grindstone, as it is a good file. When you want one, don't send diameter, width of face, and about how fine grit you want, to a dealer, and then go it blind. Go down to the wharf yourself. A grindstone don't cost much in comparison with the work it will do, and you can afford to throw in half a day and a couple of dollars for the sake of getting a good one.

Don't pick for too big a stone. Three feet is large enough for shop use. I want to get almost on top of a stone when I grind; then I can reach well over beyond the center. The water runs back on to the stone, instead of up the shirt sleeves. The tool can be held down, whereas, if you grind on front of the stone you must bear *up* all the time, and can't hold the tool half as steady. When a stone runs from you, and you can't get the other side of it, if you can't do any other way, you had better put in a left-hand water wheel and run the other way.

When you find a stone on the wharf that looks about right, take a mallet or block of wood and strike upon it in several places. If there are any cracks and shakes in that stone, you can "hear them." Turn the stone over and examine the other side. With a cold chisel and hammer chip off a thin scale. It should break between your fingers, and almost crumble when rubbed rather hard. If it is hard and flinty, or has any trace of slate or soapstone qualities, give it the "mitten." The stone should be almost soft enough to enable you to pare it with the cold chisel, graver fashion.

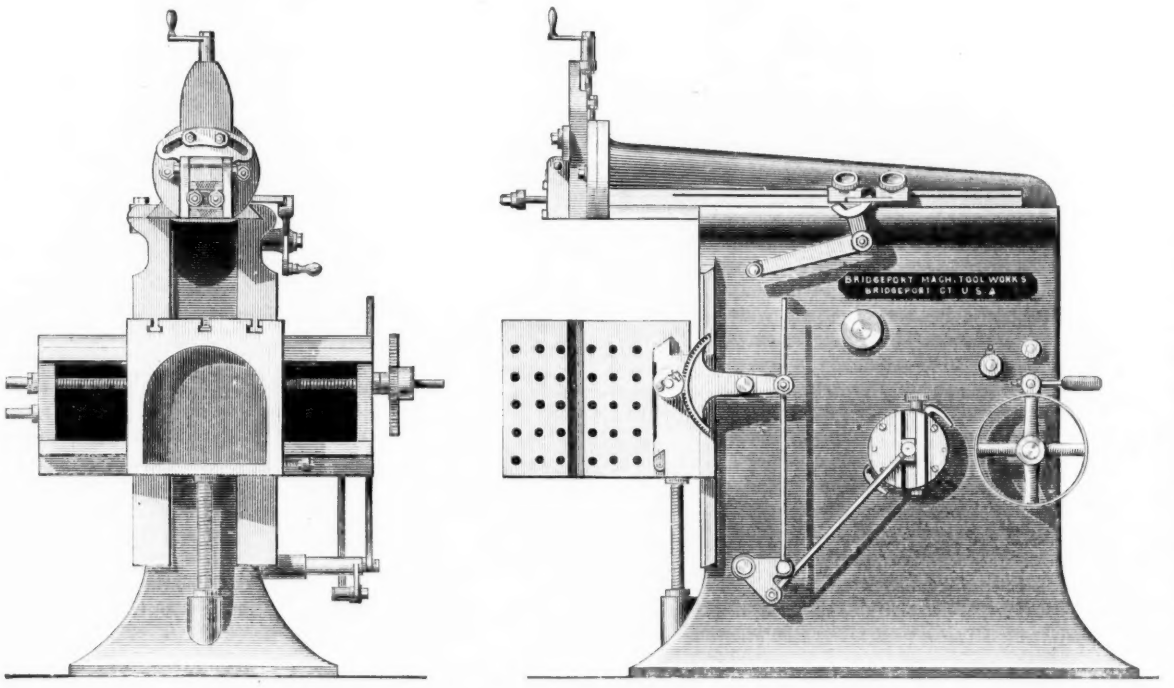
When you have got a stone to suit, have the sides trued off for flanges. All stones used to be wedged true upon a square shaft. It was a barbarous, unscientific practice. Dry pine wedges driven in tight, then wet thoroughly, the stone run too fast, is entitled to burst.

Before you wet the new stone, put a dog on the end of the shaft, water on the stone, and a "cub" on the dog. Let him turn the stone, and increase the speed until the water begins to fly off. It will commence to fly first at the point where gravity begins to assist centrifugal force, right where the stone begins to travel *down* from a point level with the shaft. Count the revolutions, figure up the speed, and put on a pulley to make the stone run about this speed. A little faster will not do any harm; the stone soon wears, and the speed of the surface decreases. When the stone gets worn two or three inches, put on a smaller pulley. Keep changing until the stone is 18″ in diameter. Then turn a groove in the center of its face 3″ deep. Fit a lot of dry pine wedges into this groove. Don't drive them too tight, or you may break off a big chunk of the stone. Now take the stone off and lay it down in the water, or where the pine wedges will get wet. Next week you can go there and get two nice 18″x4″ grindstones, just the thing for up-stairs, where you do the light work.

Don't put a nasty water trough under your grindstone. It only serves to catch dirt, mud, and any tool you happen to drop. Put a long shaft in your stone. Have the pulley three feet at least from the stone, and a bearing close to it. Cover this box with a piece of leather, and you can keep grit out of it. Put the other bearing close up to the stone on the other side. No use to oil this box. Might as well oil a water-wheel step. Make the bearing of bronze, and rig a ¼″ water pipe to discharge a stream upon it. Centrifugal force carries the water to face of the stone, just where you want it. The bearing is always lubricated, and the stone clean and ready for work. It will work, too. Use it well and it will be the best tool in the shop, except its formidable rival, the solid emery wheel.

Bridgeport Twenty-Inch Shaper.

This tool, which is of novel design, has just been added to the Bridgeport list. The shaper is convenient to operate, and is made in a way likely to secure durability in service. Careful attention has been given to the arrangement of parts and distribution of metal to secure the maximum of strength and solidity. The sliding surfaces are broad and carefully fitted by scraping. The cutter bar is operated by a rack and pinion, thereby securing a uniform movement throughout the entire length of stroke, and quick return. The running gear is the same as in the Bridgeport 16-inch planer, and is driven by two belts, cross and open, one on each side of the machine. By the employment of an improved belt-shifting device, the driving belt is removed to the loose pulley before the reversing belt is started, thereby avoiding jar and friction. Rack and gears are cut in the most approved form; and the shafts are of steel with long journals of good diameter.



BRIDGEPORT TWENTY-INCH SHAPER.

The cutter bar has an extreme stroke of 24 inches, and can be adjusted to any point desired while in operation. By direct connection with the main shaft a positive feed is obtained, varying from $\frac{1}{100}$ to ¼ of an inch.

The shaper is made by E. P. Bullard, 14 Dey Street, New York.

Mr. John Slagg, a member of the British parliament who was one of a Royal Commission appointed some years ago to inquire into the subject of technical education, has been lecturing on technical education. Referring to evening technical instruction being systematically promoted throughout Britain, he said that in no other countries were facilities and opportunities afforded to the rising generation of artisans equal to those provided in England.

Structural Changes of Iron.

It is sometimes amusing to read the intelligence thought worthy of being telegraphed all over the country as press dispatches. The other day an enterprising news collector in Indianapolis sent forth by electric transmission notes of experiments and theories on the fatigue of metals by the State geologist of Indiana. Although this State geologist has discovered nothing but what has been familiar to mechanical engineers for years, the reporter telegraphed that Dr. Collett has been experimenting upon a theory that the best of iron, when subjected to continuous strain, would undergo changes in its structure which would, after a time, render its use dangerous, and that these structural changes were the explanation of many otherwise inexplicable accidents, particularly to railway bridges. He has lately undertaken a systematic investigation, which has resulted in a confirmation of his theory. For experiment he took from the Wabash dam, at Delphi, a number of bolts and spikes, which were, when the dam was constructed, of the best quality of malleable bar iron, as is shown by the battering of the head when they were put into the structure. Of these bolts and spikes he found that 70 per cent. of the whole number were as weak as cast iron, while 90 per cent. of those which were near the bottom of the dam were worthless; yet, of those which were rotten, the tips where inserted in immovable rocks were fibrous and strong. When broken they showed polished ends to the connecting fibers, indicating that the continued vibrations of many years had polished and rounded the points of fibrous structure. A similar effect is found in "the partings" or "horsebacks" in coal mines, which become polished and striated by the continuous quiver and motion of the crust of the earth. Dr. Collett, says that all car axles, after a reasonable run, become crystallized two-thirds of the length from the hub and one-third from the outside extremity, rendering them worthless. On one Indiana railroad bridge he found that the bottom parts of the vertical strain pieces were crystallized for from two to four feet in length, and, as a precaution against what would inevitably have caused a great catastrophe, they were replaced. The matter is one of great interest to railways, and the specimens which Dr. Collett has collected in his experiments are to be sent to the Stevens Institute of Technology, where an investigation of the subject has been in progress for several years by a scientist connected with the institute.

How Mechanical Appliances Protect Railroad Crossings.

Certain inventors of railroad signals have insisted that a block system of signals can be operated with safety and efficiency automatically, without the intervention of human supervision. Many practical men, on the other hand, maintain that while an automatic system may work perfectly three hundred and sixty-four days in a year, it may fail on the succeeding day and cause more damage than would pay the wages of attendants for half a century. A good illustration of the defects of the system was lately given at Trenton, N. J.

The Pennsylvania Railroad Company has some of its crossings protected by an automatic signal which strikes a gong and displays a flag on the approach of a train. This arrangement recently failed to work when a train was approaching, and a woman was caught and killed. The coroner's jury that investigated the accident, censured the railroad company and adopted a resolution calling upon the local authorities to compel the railroad company to use safe means for the protection of the crossing.

It is cold weather for some of the companies that have started in during the past two years to get power for nothing. One concern, with big capital—on paper—that made steam with a trifling expenditure of heat, and another that furnished power without much steam, are lately reported to have come to grief.

LETTERS FROM PRACTICAL MEN.

Hardening a Piece of Steel.

Editor American Machinist:

Mr. Goodyear puts the case of hardening the piece of steel, shown in the sketch in your issue of Jan. 3, better than I have ever seen it put before. As I understand it, "F. C. F.," is particular only about hardening the convex side. I would seize it while hot in a pair of tongs, taking hold of it by the sides with tongs of such size and shape as to protect the sides from immediate contact with the water, then dip. I would use cyanide of potassium.

B. F. SPALDING.

Improved Wedge Calipers.

Editor American Machinist:

In ordinary railway machine-shop practice driving box wedges are lined up with the center-punch and trammel points. A center-punch mark, made with the greatest care by the eye, will vary from one one-thousandth to one sixty-fourth of an inch. To overcome this defect, and to ascertain the amount of the discrepancy, I designed and made, and put to practical use, while in the Chicago, Rock Island & Pacific repair shops, a pair of elongated extension calipers. With these I measured from the face of the front dead wedge to the face of the back dead wedge, and compared the two sides. With these calipers the least iota difference would be shown. In the construction of these calipers but five pieces are used. A piece of $\frac{5}{8}$-pipe 5 feet long, with pipe-thread on one end; this end is slotted with four slots two inches long; to this is a thumb nut which, on being screwed up, will compress the pipe; into this end is fitted a $\frac{5}{8}$ round rod so as to move easily. The caliper points should be of tool steel, 8″ long, with a round hub in the center and a handle on one end. One hub is drilled to fit the blank end of the pipe and fastened permanently with a set-screw. The other is fitted to the $\frac{5}{8}$-rod in the same manner. The two points are kept on a line permanently by a $\frac{1}{8}$ key way, into which is fitted a pin through one side of the pipe. These calipers can be used for many purposes, but for squaring driving box wedges they are "ne plus ultra."

W. TARRANT, M. E.

Results from Cable Road on the Brooklyn Bridge.

Editor American Machinist:

In the AMERICAN MACHINIST of January 3d, 1884, is a highly entertaining and instructive article by A. H. Mathesius, M. E., entitled "Power Needed in Operating the Cable Road on Brooklyn Bridge." As many of your readers, and the public generally, are interested in anything pertaining to "our bridge," Mr. Mathesius deserves thanks for the information which he has kindly furnished in regard to the working of the cable and road. But at the same time I wish to question his conclusions in regard to economy of the system employed.

While the present system is perhaps as economical as any cable road in the same place, and working under the same conditions could be, still the statements, in substance, that the cars are drawn across the bridge with about half the power that would be necessary for any other system, and that but about 20 per cent. of the 270 indicated horse-power is required to drive the machinery and cables are not so very evident. We also learn that at times there are six trains of two cars each attached to cable; that each train will weigh about 26 tons; that the velocity of cable is 900 feet per minute; that the maximum grade of road is 3.25 per cent., and that the duty required of driving engine varies greatly, owing to the fact that every other minute will bring two trains on one side, and one train on the other side of the summit of bridge; and this being the case on both tracks, it will throw two unbalanced trains against or in favor of the power.

From the above data we perceive that, in fact, the only actual work required of driving engine when doing its maximum duty is the propelling of two trains, of 26 tons each, up the grade mentioned and at stated speed, and taking the generally accepted ruling for power consumed in propulsion of trains, and to it adding a liberal allowance for resistance due to high winds, we fail to account for more than 56 actual horse-power consumed per train. This being the case, then, of the 270 indicated but 112 actual horse-power has gone into work, and the remaining energy employed in overcoming friction of cable and engine, showing clearly that the friction of cable loaded and the friction of cable unloaded, are two entirely different factors.

This enormous loss can be more readily appreciated by an inspection of the tightening mechanism necessary to keep the cable taut, great length of cable and its numerous bends.

As before stated, it is not my object to criticize the cable road or its working, but I do not consider the saving so great as is generally supposed.

As Mr. Mathesius has asked, "What other system will do this work with this expenditure of power?" while I do not propose to specify any particular system, still for illustration let us assume, that we have what we will call an ideal system, and that by this system it is possible, first: that we can convey the power direct from engine to cars without loss of energy during transfer, and also that the trains on the down grade, can store up, and give out their surplus energy in such a manner that the trains on the up grade will be assisted by it, this storage and transfer to be accomplished without loss.

We would then have at times three trains in transit traveling on the up grade at the same moment, and as there is but one train on the steepest and the third train on a less steep grade, we must in calculation of power consumed, consider the average maximum grade on which the three trains move. In this case, we are informed, it is about 2.7 per cent, and from the afore-used ruling we find that each train is now consuming but 43, or a total for the three trains of but 129 actual horse-power.

If to this be added the surplus energy given out by the other three trains, plus 20 per cent. due to friction of engine and transfer, we would have but about 154 indicated horse-power against 270 which is now required.

It is not my object at the present time to predict by what means this economical transfer of energy could be accomplished, but should a new system be required for the bridge I do not doubt but that a better showing for economy could be made than is the case at present, especially when we consider with what rapid strides electro-dynamics is taking its place in commercial value for such duty, and that we might probably look in this direction for better results.

WILBUR H. JONES.

Tendency of Curved Tubes to Straighten.

Editor American Machinist:

Mr. Nagle, in his communication relative to the subject of the tendency of curved tubes to straighten, has been somewhat inconsistent in his statements. In his first communication (Nov. 29) he says that, "if the curved tube is circular in cross-section, steam or fluid pressure does not tend to straighten it out;" but in the issue of Dec. 27, he says that the rubber hose does tend to straighten out, "by the enlarged circle rubber would permit it to make, and that enlarged circle compels a change of curve exactly analogous to the case of the flattened tube of the Bourdon gauge."

Now it is evident that a tube of circular cross-section, of whatever material it be made, if subjected to internal fluid pressure does tend to increase its cubical capacity by the enlargement of its internal area. And it follows that the increase in capacity of the tube is due to the enlargement of its circumference when subjected to internal pressure, and this enlarged circumference is the true cause of the tendency to change form of curved tubes of circular cross-section.

The fallacy of Mr. Nagle's theory of surfaces of any form to retain that form when subjected to pressure, lies in the *impossible conditions* assumed.

If we were to apply the theory to flat surfaces, as well as curved, we should get the form for strength, that is to say, a section equally strong throughout, but not one *without tendency to change form.*

W. F. B.

Tendency of a Curved Tube Not to Straighten Practically Demonstrated.

Editor American Machinist:

The discussion on the tendency of a curved tube to straighten, has interested me very much, and in accordance with the suggestion of A. F. Nagle, that a gauge manufacturer settle the matter by an experiment, I made a curved tube the same as used in the Bourdon gauge, with the exception that it was of circular cross section, instead of the elliptical, rectangular, or oval sections of the springs in use in various Bourdon gauges as made by different parties.

The diameter of this tube was $\frac{5}{16}$″, thickness of metal, $\frac{1}{32}$″; diameter of bend, 7″; length of tube, 17½″. These proportions would have insured a very sensitive spring, if it had been of a flattened or oval section.

I connected this tube to our testing apparatus, subjected it to an internal pressure of 1,000 lbs. per square inch, and no movement whatever resulted from this high pressure.

I have always been satisfied that a bent tube of circular section could not be straightened by internal fluid pressure, but I never had a practical demonstration of it until I made this experiment, which proves that the reasonings of "Six H," are without foundation. It also proves that the tendency to straighten is not caused by a greater pressure on the larger half of the tube, for in that case a bent tube of circular section would be straightened.

A. BEMENT.

The Balance of Rotary Parts of Machinery.

Editor American Machinist:

Noticing some discussion lately in the AMERICAN MACHINIST on the subject of balancing the rotary parts of machinery, and believing all of your correspondents to be more or less right, I beg leave to give you a few ideas for consideration. The "throw" of any unbalanced mass revolving around a fixed axis is toward the heavy side, because the center of gravity at which the mass may be assumed to be concentrated, in computing the centrifugal force, is toward the heavy side. And this force is always from the axis of rotation; but a mass revolving around a free axis will assume an axis which passes through its center of gravity. The question which seems to be in debate is: "Will the revolving mass assume this axis against the resistance offered by a comparatively rigid shaft?"

The question does not seem to be a difficult one. An unbalanced mass, revolving on a yielding shaft, will revolve around its center of gravity, if the resistance offered by the rigidity of the shaft is less than the force on which the law depends that a free body revolves around its center of gravity.

Therefore, the question whether the heavy or light side runs out depends on the amount the mass is out of balance, the velocity of revolution, and the rigidity of the supporting shaft. An illustration familiar to all machinists, is the starting of an emery wheel which is out of balance. At first the stand is shaken, and as the speed becomes greater the vibrations are more violent, until at last a speed is attained at which the tendency of the wheel to revolve around its center of gravity overcomes the resistance offered by the shaft, and in the twinkling of an eye all is comparatively quiet. Sometimes an outsider comes in the shop to grind something; he goes to start the wheel and it shakes so hard he gives it up, when the boss, seeing his trouble, says, "Let her go; she will run all right when she gets her speed."

I will give an account of an experiment I tried about eighteen months ago, as it may be of interest to some. I drilled holes in one side of a cast iron disk to make it out of balance, fastened it on a light shaft and put it in a speed-lathe, so that the disk ran true when the lathe was slowly revolved. On running the lathe, say, 300 revolutions per minute, the disk vibrated violently, and by holding a piece of chalk against it I found that it marked on the heavy side. By running the lathe faster, say, 600 revolutions per minute, the vibration was very much less, and the chalk marked on the light side.

In the latter case, I do not propose to determine how much, or in what direction, the actual axis of rotation was made to differ from the center of gravity by the spring of the shaft, as it involves a mathematical investigation which I do not care to go into.

JOHN COFFIN.

Asbestos Packing for Unions.

Editor American Machinist:

Years ago I used to have trouble with leaky unions, packed with rubber in the ordinary manner. Then I began to use asbestos wick for packing, and since then have had no trouble. The last union I packed was two years ago, and those packed then are good for two more years.

J. MAY.

Mr. Joy on Infringement of His Valve Gear.

8, VICTORIA CHAMBERS, WESTMINSTER,
LONDON, December 3, 1884.

Editor American Machinist:

I have seen in your paper, the AMERICAN MACHINIST, November 1, a letter signed "G. S. Strong," he claiming to have invented one of the modifications of my well-known valve motion.

* * * * * * *

Referring to Mr. Strong's letter and his pretensions to have invented a "*slight difference* in construction which makes all the difference in the world in the practical working of the 'two' gears," I deny altogether, and without fear of disproof, that *two* gears can be made out of them. The slight difference claimed by Strong is clearly included in my patent 252,224, page 2, line 54, etc., where it is stated:

"Instead of the center of the lever *A* sliding in a slot link, it may be hung by a suspending link. . . . The point of suspension of such suspension link being adjustable, etc."

Indisputably the different forms of the gear are but modifications of the same invention, and follow each other necessarily in the working of it out to get various conditions.

Four years ago I built large rolling mill engines and other engines on this same plan of the sword arm to carry and control the adjustment of the swing or suspension link suspending the center of the lever *A*, and since that time I have had very large engines built where the link was carried by a lever, and which, moreover, were published by the British Institute in 1880.

These different designs have been simultaneously published in the United States from tracings and photographs furnished to Mr. Turner at the time the engines were built; so that, in fact, nothing was left for Mr. Strong to invent or to patent beyond what was already in possession of and before the public—Strong's "slight difference" having been covered by my patent and built and published by me, as stated, long ago.

Mr. Strong goes on in his letter to depreciate my gear, and to speak of it as "not practical" for the purpose for which he wished to use it, viz., for a locomotive. Against this I set the broad fact that there are 300 locomotives running with that very valve gear. That they are running successfully is proved by the fact that the railways running them are still building them. Also that a large proportion of them are running the fastest and heaviest express trains on the leading lines of England, etc., much of the running being continuously at 60 miles an hour and upwards; which is tolerably good evidence to any one with intellect, in spite of Mr. Strong, that such a valve gear is eminently practical for locomotives; to say nothing of marine engines, where it has been largely adopted.

[For its endurance as against wear and tear

Mr. Joy refers to several letters published by Mr. Webb, of the London and Northwestern Railway, on the subject. Also to the communication signed "J. T. M.," in AMERICAN MACHINIST, November 15, where the writer, a well-known American locomotive superintendent, says: "Concerning repairs, I can only say that the first engine built of this type was in the shop for inspection and repairs at the time of my visit, and the amount of wear was so small, considering the mileage made, that it was a source of surprise to me. Let the truth prevail."]

With a valve gear so clearly practical and endurable, Mr. Strong need not have gone out of his way to twist it out of form in the endeavor to make another out of it to which he might lay claim. Even if he, and not I, had invented, built, and published this "slight difference"—it being such a very slight difference and a small part only of the whole valve gear—it could not have been used without the sanction of the original patentee, being a mere servient patent used in connection with the whole of the rest of the mechanism, making the whole liable to royalty.

* * * * * * *

I met Mr. Strong in England at one of our scientific societies. He accepted my hospitality. I showed him in good faith all I was doing with my gear, and arranged with him to introduce it on a new type of engine he had in contemplation in the United States, I, on my part, agreeing to give him a liberal concession for such introduction. This arrangement was afterwards confirmed by letter. I furnished him with my complete tracings of my best practice to enable him to carry out the adoption.

* * * * *

The validity of my patents, and the relation of my invention to all other valve gears, has been closely investigated by the legal and mechanical experts of the English railroad companies, and approved by them, which is evidenced by my present transactions with them

DAVID JOY.

John Fink Wanted in Canada.

The following extract is from a recent issue of the *Montreal Gazette:*

"A *capias* was issued on Saturday at the instance of Mr. John Turnbull, managing director of the Cornwall Manufacturing Company, for the arrest of Mr. John Fink, doing business in Baltimore, Md., under the style of Henry Fink & Son, for the alleged fraudulent sale of the right to use Fink's patent oil mixture. The *capias* was at once placed in the hands of a bailiff, with instructions to look out for him. Mr. Turnbull states that in 1879 the Cornwall Manufacturing Company purchased the receipt for the manufacture of this patent oil mixture, which was guaranteed to effect a saving in the oil used in the establishment of 40 per cent. The purchase of this receipt gave the company the sole right to manufacture this mixture in Canada. A few days ago Mr. John Fink came to this city, and, going to Mr. Turnbull's office in this city, sold the sole right to use the patent in Canada over again for $100, together with the saving which it would effect during the first three months of its use. On sending the receipt to the company at Cornwall, however, it was returned to him, with the information that they had already purchased it in 1879, and had discarded it as useless some time ago. Hence the issuing of the *capias*."

A person answering the description of John Fink was in New York City the day after Christmas, trying to sell the Fink mixture recipe to a gentleman in the slate trade. He gave his name as O'Donovan, and was in a hurry to catch a train to Chicago. He exhibited a certificate of a recent sale to the proprietor of a slate quarry in the vicinity of Bangor, Me.

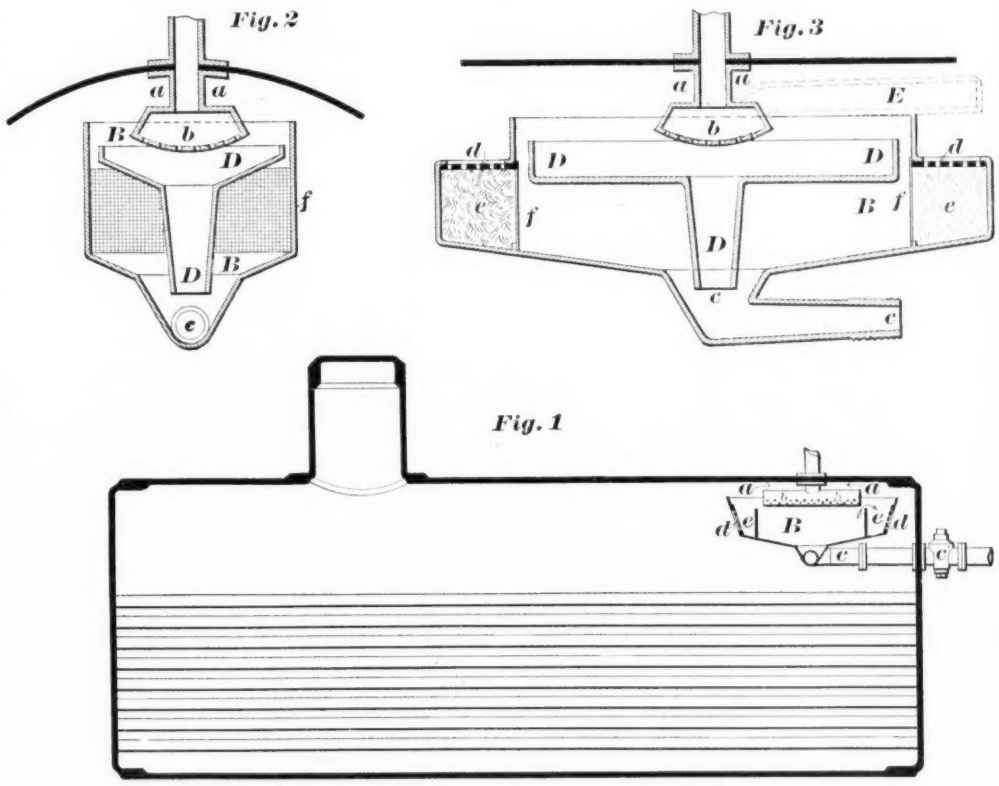
The *Baltimore American* of December 30 publishes the facts noted in above extract from the *Montreal Gazette*, and says:

"The Fink family reside in an elegant residence in Baltimore County, built by the late Henry Fink about ten months ago. The business is carried on by the family, and all the transactions and correspondence is conducted from their home, which is also the office. Mr. Fink acquired a considerable fortune by the sale of his patent."

Those who wish to be informed about Fink and his humbug mixture should get copies of the AMERICAN MACHINIST of following dates: March 22, April 12, May 10, and July 12, 1884, which contain a large number of letters from manufacturing establishments who were deceived into buying "shop rights" to use the mixture.

Mahony's Feed-Water Heater and Clarifier.

It is well known to engineers that many of the damaging impurities in feed water for boilers are not precipitated at a temperature due to exhaust steam, and hence are not removed by the use of the ordinary exhaust steam feed water heater. In practice many boilers are fed with cold water, when all the impurities enter the water space, in other instances the injection water is fed, the result being practically the same, while the use of the ordinary exhaust feed water heater, with such means as are employed to get rid of impurities, will only remove such as are precipitated at a low degree of heat. In order to properly purify the water, it must be done at the temperature and under the pressure of the steam in the boiler.



MAHONY'S FEED-WATER HEATER AND CLARIFIER.

The object of the device represented herewith is to provide for filtering and clarifying feed water by raising it to the proper temperature while on its way to the water space of the boiler, and for blowing off the impurities separated, to the end that no scale-making material whatever shall enter the water space. The manner in which this is accomplished may be seen by the engravings.

Fig. 1 represents, in section, a boiler fitted with this appliance, and Figs. 2 and 3 cross and longitudinal sections of clarifier pan. It will be understood that details of construction are varied somewhat to suit varying conditions, and that these variations are shown to some extent in the engravings.

In operation the feed is admitted through the perforations as shown at *b*. In all cases the upper part of the apparatus is in the steam space of the boiler, so that the water passes in a divided state through steam of full boiler pressure to the pan *B*. In all the engravings the water connection is represented as entering through the top of the shell, and so direct to the pan *B*. The dotted lines *E* represent another plan, and under ordinary circumstances a better one, the water pipe entering at one end of the boiler and traversing the steam space by which the water becomes heated before reaching the point of delivery to the pan. The feed pipe can enter as most convenient, passing for any distance through either the water or steam space of the boiler. The water in pan *B* being as hot as that in the boiler, the impurities are precipitated and are occasionally blown off through pipe *c*. The blow-off cock, *c'* is for convenience shown near the boiler. In practice the pipe *c* is usually extended to the main blow off pipe, and the cock *c'* placed near the latter. By this means the water in pipe *c* being still, the foreign matter taken from the water will settle in this pipe, and need be blown out only at considerable intervals. From this pan the water gradually rises and overflows through the steam to the water space, water cooler than that in the boiler never coming in contact with any of the sheets.

When the impurities in the water are such as to make it advisable, it is subjected to chemical action by placing in pan *B* such metal as has close affinity for the impurities that will not be precipitated by gravity.

At *D*, Figs. 2 and 3, is represented a special guard plate, sometimes used in instances where the feed water is particularly foul. This guard plate receives and conducts the water directly to the bottom of the clarifying pan, preventing foreign matter from finding its way to the overflow.

At *d*, Fig. 3, are represented perforated plates made of metal, best suited to the water, that is having affinity for the impurities. Before the water enters the water space it must first pass these plates.

In some instances, pockets, *e*, Fig. 3, are located out of reach of the blow off, and in these pockets filtering material is placed, and, as the water on its way to the water space must pass these pockets, foreign matter not previously precipitated is stopped in its passage. In extreme cases these pockets may be filled with metal as granulated zinc, or zinc shavings; *f* represents a perforated partition, through which the water must pass before reaching pockets *e*.

It will be understood that this apparatus may be very simple, where there are no impurities in the water that will not be precipitated by gravity when subjected to the full heat of the boiler, and that particular arrangements, some of which are shown, are used to meet special conditions. Before entering the purifier, of course the water may be heated in any degree by an ordinary feed-water heater, or it may be heated by live steam outside the boiler, but in this method of heating to the temperature corresponding to boiler pressure there is no loss of heat from radiation. It is not necessary that the apparatus be altogether in the steam space of the boiler; the lower part of it may be in the water space. It may be, when there is not room in the boiler proper (which will not be the case except in peculiar boiler construction) be located in a special drum. The depth of pan *B*, and its general form, are made to suit the conditions under which it must be applied.

James Mahony, 73 Astor House, New York, is the inventor and manufacturer of this apparatus.

In some parts of Mexico complaints are made that rich mines are miserably supplied with the mechanical appliances necessary for doing work safely and efficiently, while the health and comfort of the miners appear to receive no consideration whatever. In many deep mines no cages or safety appliances are provided for access to the works, and miners have to climb ladders that are very unsafe.

The Pittsburgh Locomotive Works Company have a room fitted up in their office for a night-school, where apprentices belonging to the shops are given lessons in drawing.

James Montgomery.

James Montgomery, a mechanical engineer and inventor, died at his home in Philadelphia on the 28th of December. Mr. Montgomery was well known in mechanical circles at one time as the inventor of the boiler that bore his name. He entertained extravagant hopes of the saving that could be effected by lengthening the channels through which the products of combustion had to pass, and the result was disappointment. The boiler received some application, but it was extremely awkward to make, and the inventor's enthusiastic advocacy failed to put it into permanent use. Mr. Montgomery was one of the first to put a partition between the tubes to divide the products of combustion.

The Selection of Apprentices.

Messrs. Denny & Brothers, of the Leven Shipyard, Dumbarton, are abandoning the practice of taking premium apprentices, and in place of these they are recruiting the lower branches of their staff by means of competitive examinations, the vacancies being awarded to the most successful candidates. Two apprentices are wanted just now, and the terms on which they are to be accepted are as follow: The applicants must not be under fourteen years of age, must belong to the town of Dumbarton, or be at present apprentices in Leven Shipyard, and must be able to show good certificates of health and character. The subjects of examination will embrace: (1), Mathematics, including arithmetic geometry, as far as the first two books of Euclid; algebra, as far as and including simple equations and logarithms; (2), theoretical mechanics, as required for the elementary stage of the Science and Art Department; (3), practical, plane and solid geometry, also as required in the elementary stage of the department's examinations; (4), freehand drawing; (5), mechanical drawing. For the first subject a maximum of 200 marks will be given, and for each of the other four subjects a maximum of 100 marks, making in all 600 marks as a maximum for the five subjects. No candidate will be admitted who does not obtain 40 per cent. of the maximum number of marks. Successful candidates, in the event of their conduct and diligence being satisfactory, will be retained in the drawing office for an apprenticeship of five years, the rate of payment for which will be, respectively, £20, £30, £40, £50 and £60 per annum. In the interest alike of scientific shipbuilding and of Messrs. Denny & Brothers, we cannot but wish well to this new method of recruiting the profession from the most intelligent of the candidates who present themselves, but we scarcely understand why the selection should be limited to youths at present residing in the immediate neighborhood of the works.—*Engineering.*

A New Rock Drill.

BY FREDERICK A. HALSEY, OF NEW YORK

A PAPER READ BEFORE THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

In the invention and design of this machine, it was the writer's object to obtain a better steam distribution than had before prevailed in machines of this class. The chief resulting differences between this machine and others are as follows:

1. In the machines in general use the motion of the piston is arrested at the conclusion of the return or inboard stroke, by a live steam* cushion obtained by giving the valve a great degree of "lead." In this machine the piston is stopped (so far as is possible so to do) by an exhaust steam cushion obtained by closing the exhaust port soon after the return stroke has commenced, and the steam thus compressed forms a portion of that used to effect the succeeding striking stroke.

2. In the machines in general use the steam is used without expansion. In this machine expansion is introduced to any desired extent.

3. The machines in general use strike a cushioned blow. This machine strikes an uncushioned blow.

The cushioned blow is a necessity with the valve gears heretofore usually employed—this necessity arising from the following circumstances: The length of stroke of a rock drill is an uncertain quantity, since, as the drill hole progresses in depth, the cylinder must be correspondingly fed forward; but to effect this feed with perfect regularity is found to be an impossibility. The effect of an irregular feed of the cylinder is to vary the point marking the end of the stroke of the piston—the approach of the piston to the lower cylinder head varying from stroke to stroke. Moreover, in starting a hole, and under certain other circumstances, it is occasionally desirable to be able to feed the cylinder forward, so as to shorten the stroke still more than is actually necessary to accommodate the usual irregularity of feed. In brief, the machine must be able to take strokes of considerably less than normal length, without failure to trip its valve in order to continue in uninterrupted action. This circumstance has usually been provided for by simply giving the valve a great degree of lead at the *lower* end of the cylinder, tripping the valve at a point previously decided upon as the end of the shortest stroke to be allowed, and then submitting from necessity to the loss of power due to the cushion thus introduced into all strokes of usual length. In the machine about to be described, provision has been made for this irregular feed and length of stroke; but, nevertheless, when full length strokes are made, the valve does not move nor is steam admitted below the piston, until the actual delivery of the blow.

Figs. 17, 18, 19, and 20 are longitudinal sections taken on the broken line *A B C D* of Fig. 21, the piston and valve being shown in a number of successive positions. Fig. 21 is a cross section on the line *E F* of Fig. 17.

In Fig. 17 the piston has just completed its striking stroke, and is ready to commence its return stroke. The steam which effected the preceding striking stroke was exhausted through the opening *h*, which forms the only exhaust port for the upper or left-hand end of the cylinder. Steam enters at the supply nozzle *a*, flows through the longitudinal groove *b*† in the cylinder (seen also in Fig. 21), to the broad, shallow circumferential groove *c* in the piston. This circumferential groove *c* forms, in effect, the steam chest of the machine, and from it the steam is distributed alternately to the opposite ends of the cylinder. Through the passage *d*, steam pressure is maintained in the lower end of the valve chest, firmly holding the

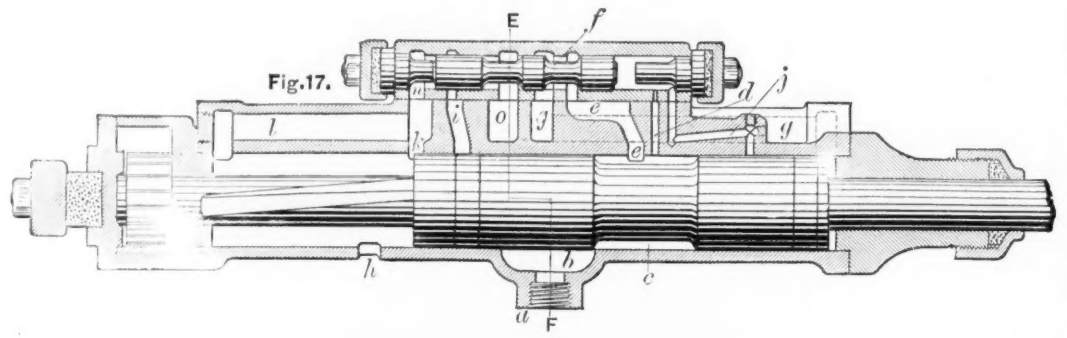


Fig. 17.

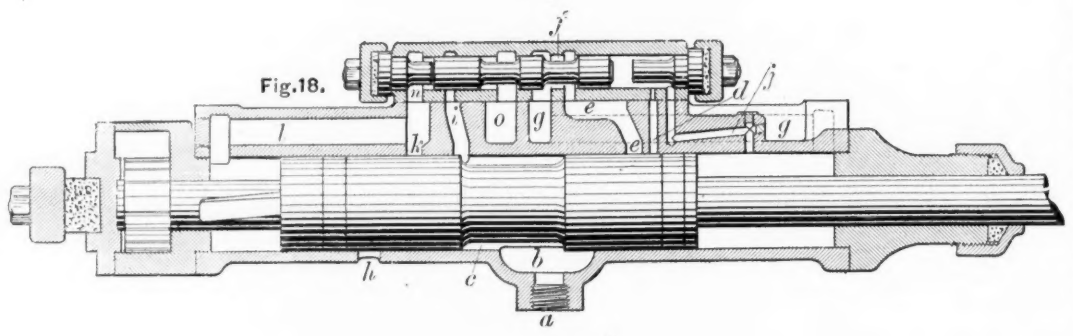


Fig. 18.

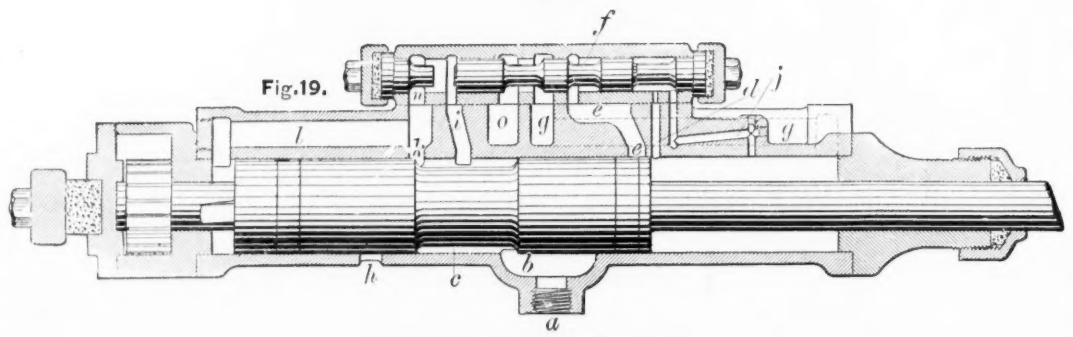


Fig. 19.

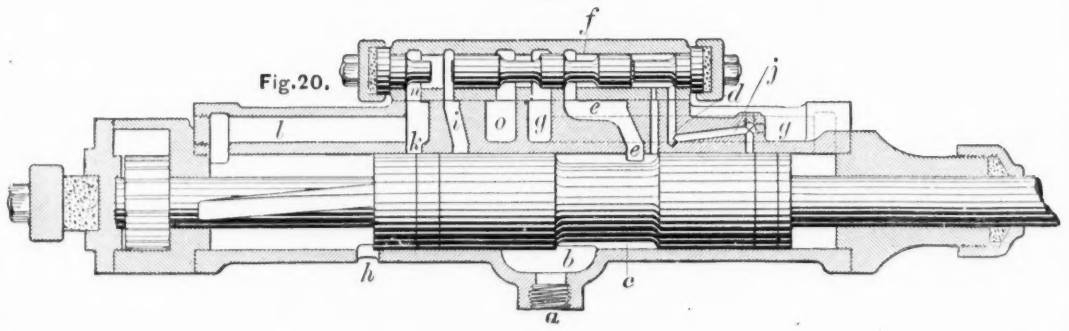


Fig. 20.

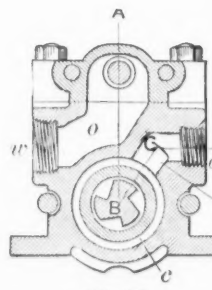


Fig. 21.

valve in the position shown. Steam flows through the passage *ee*, and from this through the neck *f* of the valve to the passage *gg*, which in turn leads it to the lower end of the cylinder. The piston now starts upward, and presently takes the position shown in Fig. 18. In passing from the position of Fig. 17 to that of Fig. 18, the piston has closed the ports *d*, *e*, *h*, and opened *i*, *j*. Closing *h* confines the exhaust steam in the upper end of the cylinder, forming an exhaust cushion before the piston, and accomplishes the first improvement named above. Closing *d* merely isolates the steam already in the end of the valve chest. Closing *e* cuts off the supply of steam to the lower end of the cylinder, and for that end effects the second improvement aimed at. Opening *i* has no effect, as its upper end is still closed by the valve. Opening *j* establishes communication between the lower ends of cylinder and valve chest, and hence as expansion goes on from the cut-off, the pressure acting on the end of the *valve* will gradually fall. In Fig. 19 the piston has ascended still further, and uncovered the port *k*, admitting steam through the passages *l* and *n* respectively, to the upper end of the cylinder and valve chest. The former completes the work of stopping the motion of the piston; the latter, being opposed only by expanded steam at the lower end of the valve, as just explained, shifts the valve downward, thus establishing communication between the port *gg* and the exhaust passage *o*. The piston now commences its descent, and closes and opens the various ports in the reverse order to that just explained. Closing *k* has no effect, as *i*, being now open, the steam can pass through it to the upper end of the cylinder. Closing *i* effects the cut-off for the upper end of the cylinder, exactly as closing *e* did for the lower end. Opening *e* has no effect, its upper end being now closed by the valve. Opening *h* effects the exhaust.‡

In Fig. 20 the piston has just uncovered the port *d* leading to the lower end of the valve chest, and it has thus established the condition which will reverse the valve, and insure the next upward stroke. As the port *d* is *just* uncovered, and no more, the piston is at the point marking the termination of its shortest working stroke. Should the piston stop short of the position shown (by reason of excessive feed), the port *d* would not be uncovered, the valve would not reverse, and the machine would stop. As will be seen, the piston is at some distance from the lower cylinder head, this distance representing the latitude of irregularity permitted in the feed. The piston may stop anywhere between the end of the cylinder and the position of Fig. 20, and the action will continue. In order to effect the third improvement (the uncushioned blow), it is necessary to provide an arrangement which, notwithstanding the passage *d* is always opened at the position shown in Fig. 20, shall yet, when full-length strokes are made, permit the piston to pass on and complete its stroke without the movement of the valve actually taking place until the delivery of the blow. This is effected by simply constricting a portion of this passage *d*—making it of such small size that the passage through it of the steam necessary to move the valve shall be delayed until the piston has had time to pass on and complete its stroke. In the machine as actually made, most of the ports opening into the cylinder are arranged in pairs, and diametrically opposite one another, to obviate side pressure on the piston.

Figs. 22 and 23 are indicator diagrams§ protographically reproduced from the original pencil lines, and being taken at working pressure, with wide-open throttle, unrestricted speed, and full-length stroke, illustrate the action of the machine. Fig. 22 is from the upper end, representing the striking stroke, and Fig. 23 from the lower end, representing the return stroke. At *p*, Fig. 22, the piston is in the position of Fig. 17. At *q* the exhaust port *h* is closed and compression begins; at *r* the port *k* is opened, full-pressure steam enters, stops the piston at *s*, and reverses the valve; at *t* the port *i* is closed and expansion begins; at *u* the port *h* is opened and exhaust takes place. At the lower end of the cylinder there is no gradual rise of pressure like that from *q* to *r* of Fig. 22. At this end the rise of pressure is practically instantaneous, and the result is the undulations of Fig. 23. While, however, the upper side of Fig. 23 is about valueless, the lower side renders clear the action which it is desired to show. As stated, the machine was running its full stroke—as near to its lower head as was considered safe—nevertheless, there is no lead whatever shown. At *v* the exhaust from the upper end of the cylinder occurs, and the crossing of the two exhausts produces the flutter shown. The port *d* is also opened at *v*, but it is clear that the steam is not admitted until the end of the stroke is reached.

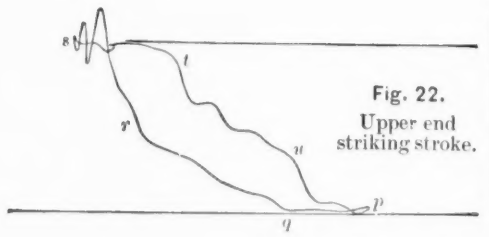


Fig. 22.
Upper end striking stroke.

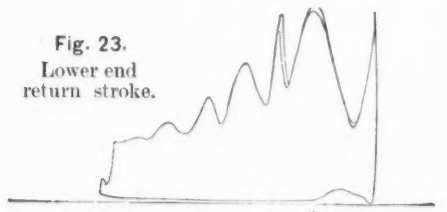


Fig. 23.
Lower end return stroke.

INDICATOR DIAGRAM FROM THE ECONOMIZER ROCK DRILL.

Air pressure 55 lbs. (gauge pressure.)
Throttle valve wide open.
Speed approximately 400 blows per minute.
Scale of spring 60 lbs. per inch.
CROSBY INDICATOR.

* For the sake of brevity, the word "steam" will be used throughout this paper to designate the driving medium. It will be understood that the devices described are equally adapted to use with compressed air.

† The longitudinal groove *b* is of such length as to maintain constant communication between the nozzle *a* and the circumferential groove *c*. Its office is to lessen the otherwise inconvenient length of the circumferential groove *c*. This, in turn, diminishes the length of piston and cylinder, and hence weight of machine.

‡ In the actual machine a covered passage leads the exhaust steam from the port *h* to the passage *o*, so that the exhaust from the two ends of the cylinder escapes to the air through a single outlet, *w*, of Fig. 21.

§ Taken with the machine operated by compressed air.

It will be observed that the point of cut-off depends upon the position of the ports *e*, *i*, lengthways in the cylinder, and can be varied at will in the design and in the two ends of the cylinder independently. It is freely recognized that fuel is but one of many items of expense, and that in many situations speed of execution far outweighs any economy in fuel that might be realized through the use of the expansion principle. To meet both situations—those where economy and capacity, respectively, are leading objects—two classes of machines are being made, one having cut-off on both strokes, and the other on the up-stroke only, and giving the effect of the uncushioned blow entirely to increased power. The first is named the "Economizer," and the second the "Slugger," and either is furnished as the situation requires.

Locomotive Economy.

BY ANGUS SINCLAIR.

At frequent intervals, for many years, railroad managers and master mechanics have engaged in zealous economy revivals, and the text most frequently preached from has been, "How shall we reduce the expenses of running locomotives?" Each awakening of this character has nearly always resulted in bringing about reforms and reductions that served the cause of economy without impairing the efficiency of the locomotive service; yet much remains to be done to render the American Locomotive as economical a fuel burner and steam user as it ought to be. Probably the most efficient reforms in our locomotive departments since coal burning was made successful, have been in the methods of doing repairs and extending the daily mileage of the engines. Great attention has been devoted of late years to increasing the ratio of heating surface to cylinder content; means of effecting and regulating combustion have been improved, and higher steam pressures have been introduced, all of these reforms giving some return in coal saving. Singularly enough, while the locomotive has received solicitous attention with the view of increasing its efficiency, the men who manage the machines have been passed without more than transitory notice. The observation is occasionally made by sharp superintendents and master mechanics that the most fertile field of saving would be through the enginemen, but on the great majority of roads this field remains uncultivated. At recent master mechanics' conventions educating engineers and firemen into doing their work economically has been investigated and intelligently discussed, and the best methods pointed out, yet for some inexplicable reason the recommendations have not been carried out, and the worst methods of firing and extravagant ways of operating the engine are still common on the majority of our railroads. It is no wonder that many interested in having locomotives handled economically are protesting that investigations made at much labor and expense by the Master Mechanics' Association prove abortive through the recommendations failing to receive vigorous application in practice.

No intelligent observer acquainted with steam engineering can be much around railroad centers without having the fact strongly impressed upon his mind that the average engineman in this country is not interested in saving fuel. In all directions engines may be seen standing around blowing heat uselessly into space as fast as ample safety valves will pass the steam through, and all the time this waste is going on the dampers are kept wide open, fanning the fire into activity, while no effort whatever is made to restrain the loss of heat. During a recent journey, which brought him into several railroad yards, the writer was curious enough to take notes of various railroad operations, and among them was the collection of data that would indicate how our enginemen were progressing in economical methods. When he saw a locomotive standing blowing off steam he noted what the engineer or fireman was doing to restrain the loss of heat. Before he tired of keeping the tally, which was too monotonous, he counted fifty-four engines with their dampers open, and six that had the dampers closed. In a few cases the engines with the open dampers had the fire door also open, with the blower on a little, which indicated that a partial attempt was being made to cool the boiler by drawing cold air through the tubes, but in most instances no effort whatever was being made to prevent waste of coal through the safety valve.

On roads where the system of giving premiums for coal saving has been introduced, the men have learned quickly how to effect coal saving, and their self-interest prompts them to save all in their power. But this system has received so little application that its teaching fails to reach the great mass of engine-runners and firemen. There are very great difficulties in the way of introducing a premium system, since it requires accurate methods of keeping coal accounts; but I think the companies that refuse to adopt the system owing to the first cost stand badly in their own light, for there are few kinds of outlay that would bring in better returns. So long as there is nothing like an accurate coal account kept by a railroad company, it is impossible to call an engineer or fireman justly to account for having a bad showing on the mileage sheet. On many roads there are coaling stations where the coal is charged to locomotives more by guess than by actual count of the tons supplied, and on other roads all coal shortages are charged among the engines generally. These shortages often form an important percentage of the fuel charged to a locomotive. When an engineer interests himself in coal saving, and keeps account of the coal received during a month, he feels discouraged if the performance sheet charges him with fifteen per cent. more coal than he received, and his zeal for economy is likely to be dampened; yet this is a common occurrence. If railroad managers are really anxious to foster habits of fuel economy among their enginemen they should not permit the discouraging practice of charging a locomotive with coal it has not used. Shortages should be met in some less demoralizing way.

Mr. Twombly, general master mechanic of the Chicago, Rock Island & Pacific Railway, has been very successful in training his enginemen in habits of steam saving by means of a blow-back pipe connected with the safety valves. Great antipathy to the device was manifested among a certain class of engineers and firemen, but Mr. Twombly insisted on keeping it on, and he believes it saves the company an important percentage of fuel. At first that grade of enginemen who like to get through the world with the least possible expenditure of personal exertion, attempted to make out that they could not keep the blow-back pipe connected without heating the tender so that the injectors or pumps would not work the water. The master mechanic held that it was their business to see that the safety valves did not blow away enough steam to overheat the feed-water, and if they could not do that it was because they were incompetent. The best men were easily convinced, but others were hard to convert to the belief that a locomotive could be run without wasting much steam through the safety valves. A few heads of the strongest objectors were dropped into the official basket, and the proselytizing effect was prodigious. The blow-back works all right there now, and a good many roads might, with financial advantage, take a leaf out of this Chicago, Rock Island & Pacific book. The principal saving derived from connecting the safety valves with the tender is not due to the economy of using partly heated feed-water so much as to the training forced upon the enginemen.

Billings' New Hand Vise.

In the construction of these vises particular attention has been paid to such a distribution of metal as would give the required strength where it is needed to resist strains, and at the same time to avoid clumsiness and unnecessary weight. They are adapted to the use of linemen on telegraph, telephone and electric light lines, as well as toolmakers, machinists, etc.

They are drop-forged from bar steel, and finished by special machinery, each part being interchangeable, so that it can be duplicated at any time at a small expense.

The jaws are parallel, which gives a strong grip, and an opening is left in the thumb-screw in which a lever can be used, if desired; the action of the screw is such that a rapid adjustment can be made. The thumb-screw at the lower end of bar can be used for giving an extra strong grip when required.

BILLINGS' NEW HAND VISE.

They are furnished either with or without loop, for strap attachment.

The engraving represents this vise two-thirds size.

They are made by the Billings & Spencer Company, Hartford, Conn.

Engineers' Trouble on the Gould Lines.

For some weeks past there have been rumors of trouble with the locomotive engineers on the Gould system of railroads running into St. Louis, and fears were entertained that a strike might result. It appears the freight business of these roads is very depressed, and the freight engineers are making very low pay as their earnings depend upon their daily mileage run. The officers of the roads wished to equalize matters by permitting the freight engineers to change off with the passenger engineers. This caused trouble, for the passenger men, who are very influential in the Brotherhood of Locomotive Engineers, objected to share their work and pay with freight men, and they sent for Grand Chief Arthur, to represent their claims and interests with the railroad managers. A conference was held where Col. Hoxie represented the Gould lines, and Mr. Arthur represented the aggrieved engineers. Some of the railroad officers strongly advocated the case of the freight men, and Mr. Arthur stood by an agreement made by the railroads in 1882, which gives passenger engineers 3½ cents a mile, and freight engineers 4 cents a mile, 100 miles constituting a day's work. It was held that this agreement implied that each class of engineers was entitled to keep exclusively to its own class of trains.

The decision given by Col. Hoxie was, that the passenger engineers should run their own trains, and this settled the dispute amicably. The passenger engineers of the Gould roads have thus gained a victory, but it is doubtful if their triumph will conduce to the prosperity of the Brotherhood, for their fight was not with the railroad company, but with their weaker brothers. Their action, in refusing to share work with those who are scarcely able to keep the wolf of want from their door, contrasts unfavorably with the action of workmen in several manufacturing establishments lately, who have petitioned their employers to take back men who were discharged through lack of work, and requested them to lessen production by reducing the hours of labor, so that all might share the burden of depressed trade.

Business is badly depressed in our own country, but it is worse on the other side of the Atlantic. In England, France and Germany much distress prevails among idle workmen. There is a great surplus of manufactured goods in Europe.

A correspondent sends a newspaper clipping, in which reference is made to the graduation of the Fahrenheit thermometer, with a request for any information we may have on the subject. Why Fahrenheit made his scale as he did has puzzled many engineers, and as expressing all we know about it, in a terse manner, we quote from Richards' Steam Engine Indicator, by Charles T. Porter, as follows: "In contrast with this [the Centigrade scale] philosophical and simple measure is the Fahrenheit scale, which begins in a blunder and ends nowhere. As 32 degrees below the freezing point was the lowest degree of cold that Fahrenheit himself was able to produce, he, in the true spirit of speculative reasoning, concluded that of course it was the lowest degree of cold that Almighty Power could produce, and assumed it as the absolute zero. * * * If the Fahrenheit scale could be at once abolished, and the Centigrade scale substituted in its place, we should be rid of an arbitrary nuisance, which is already being banished from the domain of science, and is a real impediment to popular scientific advancement."

In a recent holiday sermon, Rev. Dr. Talmage said:

"In no land are there so many happy homes as in America, such varieties of food on the table, such appropriateness of wardrobe, such healthfulness of domestic architecture. At the same time, we have to-day a great many people without work, food or shelter. The trouble is, this nation had to take a big dose of politics. Our public men have spent too much time in destroying the equilibrium of public affairs, and business staggers—stops. I enjoin upon you all in these holiday times to help the helpless and indulge in peaceful talk. In the great orchestra of complaint those who play the loudest trombones are those who have the fullest salaries and the completest wardrobes."

Referring to the condition of the times, he said:

"I prophesy that we are coming toward the grandest temporal prosperity we have ever witnessed in this country. While I am fully sympathetic with the depression abroad—and no man in this audience has a heart that more thoroughly bleeds for the people of this country who are out of work and out of bread—I prophesy national rescue; and just as it is healthful to a man when he is depressed about himself to walk about amid the destitution and suffering, and he will come back thankful to God for all the mercies he has, just so it would do this nation good if it would look across the water and see how other nations have it. So many men in this country out of employment, and yet there is not a land on earth where so many people have productive work as in this country. After wages have been cut down, as they have been to the lowest point of reduction, that lowest point is higher than the highest on the other side of the seas."

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NEW YORK, JANUARY 17, 1885.

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Railroads and Electric Motors.

A few weeks ago there seemed to be a probability that a good practical test of electric motors would be made on the Elevated Railroads of New York. It was well known that Cyrus W. Field, who is enthusiastically favorable to the use of electrical machinery, was anxious to put down a third rail the whole length of the second avenue road as an electric conductor and to introduce all the other plant necessary for operating the trains on that avenue by electricity. The most efficient machinery was to be selected, and a wide-spread belief prevailed that the experiments to be made with ordinary trains on a railroad doing a heavy business would demonstrate with certainty how well or how badly electricity was adapted for operating a railroad. It was supposed that his influence as a large shareholder and director of the Manhattan Railroad Company would enable Mr. Field to carry his scheme of electric operating into practice. We now understand that Mr. Gould, president of the company is just as much opposed to making experiments with electricity for train operating as Mr. Field is in favor of them, and Mr. Gould is supported by the majority of the directors. The position taken by Mr. Gould in the matter is that nothing has yet been done to prove that trains could be run on the Elevated Railroads by electricity so cheaply or so regularly as they are now run by steam locomotives, and he doos not think that these roads are the proper place for making experiments upon that might lead to interruptions of the traffic. So the electric motor companies will have to work out their experiments in railroad operating elsewhere.

The action of Mr. Gould and his fellow directors in opposing Mr. Field's plans is not likely to greatly discourage the friends of electrical transmission of power. Many fields are still open to their enterprises.

There seems to be a splendid opportunity spoiling in Brooklyn, for the electric motor advocates to put their system into practice without the intervention of other methods of transmitting power. The new Brooklyn Elevated Railroad is being pushed quietly forward, and a portion of it will be ready for operation within two months. No better field could be found for the use of electrical transmission, and as the motive power machinery has not yet been built, it would seem an unparalleled opportunity for the electric motor companies to get an even start. They will always labor under a disadvantage in trying to obtain a hold on roads in operation, from the fact that an expensive plant of motive-power machinery is already on hand, but this drawback does not exist with new elevated roads. If the management of the new company do not adopt electricity, as a means of moving their trains, it must be because they do not believe the statements that have been made by the advocates of electricity as to its being cheaper than motive power by locomotives.

At Hoboken there is also a new elevated railroad that is nearly completed, its purpose being to transport passengers from the ferries to Jersey City Heights. In this case the intention is to move the cars, which will be light, by a wire rope. This seems to be another good opportunity for the application of electricity.

Connected with the electric motor companies, there are men whose names are good guarantees for the faithful performance of any contract they may enter into. Now, if they are certain that their motors will operate an elevated railroad so much cheaper than steam locomotives, they ought to undertake to do the work at a certain cost. It is easy enough to ascertain the expense of operating such a railroad as the Third Avenue, for instance, with locomotives, for the accounts of the company's operating expenses are remarkably well kept, and an elevated railroad, where passenger traffic alone is carried, is free from the complexities that sometimes render the correctness of the operating accounts doubtful in surface roads.

Now, if the motor companies will guarantee to operate the Brooklyn Elevated Railroad or the Hoboken Elevated Railroad 20 per cent. cheaper than the expense incurred on the Third Avenue, and to carry on the traffic regularly and efficiently, there is no doubt but their offer would be accepted. This is no new method of proving the value of new mechanical appliances, for the Corliss engine and other devices had their merits proved by such guarantees. If any of the electric motor companies will carry a plan of this kind out successfully, they will need no more special pleading to prove that their system is economical as well as practicable. The unwillingness of railroad companies to try operating railroads by electricity is often explained as being due to prejudice against new methods. This is a mistake. The race of competition is so keen these times, that conservatism has little influence over railroad managers when they perceive any means of increasing their net earnings; and most of them are sharp enough to understand fully the advantages and disadvantages of any scheme that is presented to them.

Letting Contracts Too Low.

The *Sanitary Engineer* takes exceptions to the manner of awarding the contracts for the construction of the new aqueduct for the increased water supply of New York city—contracts aggregating about twelve million dollars. One of the objections raised is as uncommon as it is sound. It is that the prices are too low to admit of the work being done, according to specifications, at a profit to the contractors. Our contemporary indicates very clearly the probable outcome in this case, viz.: legislative relief under the ordinary "persuasion."

The commissioners seem to have made the same mistake that individuals or firms occasionally make in a smaller way. Contracting for work and materials—machinery for instance—at prices that will not afford reasonable profit is sometimes looked upon as evidence of business shrewdness, but in the end it is generally found to be quite the reverse. The party who agrees to furnish engines, boilers, or machinery of any kind below actual cost and a fair profit, may not be able to get relief through a State legislature, but there are other ways of getting even, and the fact that he is willing to assume a contract on a losing basis is presumptive evidence that he intends to avail himself of them. Specifications must be sharply drawn, and inspection unusually close to hold such a man up to the point of material loss. Self preservation is a strong incentive for any one working on a losing contract to protect himself from financial ruin.

Taking human nature just as it is, the man, firm or corporation that buys in such a way as to give the seller reasonable profit, finds the most satisfaction in the end. This is true whether the purchase is a pair of boots from the shoemaker, or fifty or five hundred thousand dollars' worth of machinery from the manufacturer. Offering direct inducements for dishonesty by making the alternative pecuniary loss is evidence of short-sightedness rather than of a high order of business capacity.

The Anthracite Coal Combination.

One of the most grinding monopolies of America is the combination which controls the mining of anthracite coal. For years this combination has kept the price of coal far above its natural level by restricting the supply whenever a tendency towards lower prices was manifested. By this means it has imposed a heavy tax upon all manufacturers who were compelled to use anthracite coal in their business, and private consumers of coal have been systematically robbed by the combination whose methods are not a whit less dishonest than those of freebooters, who in so-called lawless times levied blackmail on defenceless neighbors. There are now indications that the anthracite ring has overreached itself. Galling under the anthracite coal tyranny, many manufacturers have discovered that they can use soft coal for purposes that they had formerly supposed only hard coal was adapted. Steam users situated in localities where smoke is objectionable who have considered themselves compelled to use hard coal in their boiler furnaces, are now beginning to find out that by using smoke-preventing appliances and properly built furnaces, soft coal can be burned without causing any smoke nuisance. This tendency to change from anthracite to bituminous coal is already influencing the market and the decreased demand for hard coal is apparent on the monopolist stocks. There is no reason why anthracite coal should be employed for steam-making purposes where bituminous coal can be bought cheaper, for with properly made furnaces soft coal evaporates considerably more water pound for pound than hard coal. The relative value of anthracite and bituminous coal as steam-making fuel is well illustrated on two first-class railroads running into New York. Express locomotives on the Pennsylvania Railroad use about sixty pounds of anthracite coal to the train mile; express locomotives on the New York Central Railroad with the Buchanan fire-box do about the same train work as their rivals on the Pennsylvania Railroad with 40 pounds of bituminous coal to the mile. The superior combustion arrangements of the Buchanan fire-box give the New York Central locomotives some advantage. With the margin of economy in favor of the soft coal it is not surprising that steam users are beginning to throw off the burden of the anthracite incubus. Should the indications that the anthracite monopoly is breaking up prove correct, the final collapse will be hailed by many as a deliverance from oppression.

The hatters of South Norwalk, Conn., went on strike a few weeks ago about a question of wages. They propose to demonstrate, in an eminently practical way, that their labor is worth more than the hat manufacturers are willing to pay for it. A co-operative hat manufacturing association has been formed, with about $10,000 capital, and a shop is being erected. The jobbers in hats are willing to take their product at fair prices, and a number of orders will be booked by February 1, when the shop is expected to be running. This is decidedly the best way to settle the dispute over wages. An application of the laws of competition will convince the most skeptical as to which party to the dispute is right. One important question the workmen ought to settle before the factory starts, and that is how many chief bosses there are to be in the establishment. Many co-operative ventures fail because too many aspire to the position of head boss. All the bosses for the first year should be elected before a single hat is made. If they don't exercise their powers properly, turn them out at the end of the year.

There seems to be something wrong with appliances for electrical transmission in New York. The proprietor of a machine shop, which has a good electric light plant, wished to keep lights going at another shop a mile and a-half away. The electricians of the company calculated that his machinery would keep fifteen arc lights going at the distant station, and it is found to keep sixteen lights going in the shop where the generating plant was located. But when the connections were made it was found they never could keep more than eight lights going. That seems to be a very serious loss for transmitting electricity less than two miles.

Literary Notes.

In our issue of Nov. 29, 1884, in a brief review of "The Young Engineers' Own Book," by Roper, published by Edward Meeks, 1002 Walnut Street, Philadelphia, Pa., we pointed out some mistakes which we believed seriously detracted from the value of the book. We are pleased to be able to say that the publisher has secured the services of H. L. Stellwagen, M. E., to correct these and other errors. We may add that the book is free from formulas that

are not always understood by readers, and with Mr. Stellwagen's corrections, will, no doubt, be found a valuable acquisition to the library of practical engineers and firemen.

"Architects' and Stairbuilders' Tables and Treads and Risers," by John A. Hamilton, is a small book recently published, which will be of great service to builders and architects in saving calculations that busy men can often hardly find time to make. The publisher is William T. Comstock, 6 Astor Place, New York, and the price 50 cents.

We have received the thirty-first volume of *Van Nostrand's Engineering Magazine*, containing the monthly numbers from July to December, 1884, published by D. Van Nostrand, 23 Murray Street, New York. The volume contains a great many well-selected articles from the European technical press and a few contributed articles on American engineering subjects. Besides selected long articles, the magazine gives each month, reports of engineering societies, engineering notes, iron and steel notes, railway notes, ordnance and naval news, and book notices. Each of these departments is intended to furnish leading items of interest on the topics dealt with. A peculiarity of the railway notes is that not a single United States railroad is mentioned in the whole volume. The compiler of these notes evidently has not found out that there are any railroads in the United States. The magazine is very useful and attractive to engineers fond of studying up the most difficult technical problems of their business.

The address of J. A. Gardner, American agent for *Calvert's Mechanic's Almanac* is 46 E. 10th street, New York, instead of 132 Broome street, as we had it last week.

Collisions on the Elevated Railroad.

On the morning of December 30, the upper part of Manhattan Island was enveloped in a dense fog and four of the elevated railroad trains celebrated the event by engaging in collisions. Fortunately none of the smashes were so violent as to throw any part of the train from the structure and no loss of life resulted. The blame for each collision has been promptly placed on the engineer in charge of the train, but we hardly think that these men should be held entirely responsible. The method of operating the elevated railroads is safe enough for ordinary conditions, but even then trains are handled safely merely by the constant, unflagging vigilance of the engineer. The abnormal condition of a dense fog is not provided for, and to avoid accident is sometimes more than an engineer can do. Public safety demands that these roads should be provided with a system of block signals to protect trains, and it will only be by the adoption of such a system, already in use on all other crowded lines, that the trains can be operated in a manner that will guard against serious trouble every time a fog settles on the city. The mechanical appliances that will prevent one train entering upon a part of track occupied by another train have long been perfected, and it is merely considerations of economy that have prevented the Manhattan Railway Company from adopting them.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(18) A. F., East Saginaw, Mich., who asks for a bronze dip for iron castings will find the information in the AMERICAN MACHINIST of May 19, 1883.

(19) R. C. B., Somerville, Mass., asks: If two boilers carrying 60 lbs. pressure each are connected to a single pipe, will there be more than 60 lbs. pressure in that pipe? *A.*—No.

(20) W. H.W., Easton, Md., asks: What is the theoretical quantity of air required for the combustion of 1 lb. of coal? *A.*—It varies a little with the quality of coal. In round numbers 12 pounds.

(21) W. S. asks: Can you tell me of a composition that will wear better for safety valves than brass? *A.*—Fairly hard bronze—copper and tin—is, we believe, cost and all considered, the best for safety valves and bushes. Nickel seats are sometimes used to give a better wearing surface, but they are expensive.

(22) C. D. V., Corry, Pa., asks: What are the best proportions of metals to use for hard-soldering light steel pieces, leaving the surfaces smooth; in other words, a spelter that will melt at a low heat, and do substantial work? *A.*—For fine steel work solders containing considerable silver are used—say, 13 parts copper, 5 parts zinc, and 82 parts silver. Hard spelter is made of 67 parts of copper and 33 parts zinc. Soft spelter, of even weight of copper and zinc. 53 parts copper to 48 parts zinc make a good bronzing solder.

(23) F. P., Boston, Mass., writes: I have some arbors ½″ diameter and 14″ long to harden and grind. How can I harden them so they will not spring badly? *A.*—Heat them in a lead bath, deep enough to permit of their being put in and held vertically while heating. When hot, lift them out and dip them in the water vertically. The vessel to hold the lead need not be more than 4″ diameter; a piece of pipe stopped at one end will answer. Build the fire around the sides, but not under the bottom. They will heat very quickly in the lead.

(24) Subscriber, Lynn, Mass., writes: The heat necessary to generate steam, instead of being 212°, is 966° + 212° = 1178°. Since water boils at 212°, how is it known that this latent heat is in the steam? *A.*—By evaporating a definite quantity of water into steam, and passing the steam into a condenser and noting how much heat it will impart to a given quantity of water. 2. When a gas is compressed into half its original volume, the pressure is doubled, and so on. Does this apply to steam in an engine cylinder? *A.*—Steam is not a perfect gas, and does not follow this law exactly. For most practical purposes, it is considered to do so, as it is very nearly correct, and calculations are easily made. 3. What makes the difference in the relative volume of steam at different pressures? *A.*—The relative volume is the space occupied compared with that occupied by the water from which the steam is generated. If a given volume of steam is made to occupy but half the space its pressure is (about) doubled, and its relative volume, of course, changed correspondingly.

Business Specials

Transient Advertisements, 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Curtis pressure regulator and st'm trap. Jan. 10, p. 11.

Katzenstein metallic packing, 169 Christopher st., N Y

Presses & Dies, Ferracute Mach. Co., Bridgeton, N. J.

Steel Name Stamps, &c. J. B. Roney, Lynn, Mass

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 86 John street, N. Y.

Herbert W. T. Jenner, Mechanical Engineer and Solicitor of Patents, 632 F st., Washington, D. C.

Power Measured—F. Van Winkle, mechanical engineer, 22 Cortlandt street, New York.

Lyman's Gear Chart. How to lay out gear teeth. Price 50 cents. E. Lyman, C. E., New Haven, Conn

Foot Power Machinery, for workshop use, sent on trial if desired. W.F. & John Barnes, Rockford, Ill.

The latest Improved Tack and Match Machinery is made by White Machine Co., Waterbury, Conn.

Corresponding agents, able to sell machinery, engaged in large towns. Harris, 12 Cortlandt St, N.Y.

Pattern and Brand Letters. Vanderburgh, Wells & Co., corner Fulton and Dutch streets, New York

Consulting Engineer and Mechanical expert, C. C. Hill, 84 Market street, Chicago, Ill.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Steam Pumping Machinery of every description. Send for catalogue.

The "Wax Process" Engravings shown in the AMERICAN MACHINIST each week are made by Struthers, Servoss & Co., 32 Frankfort Street, N. Y.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 62 Chatham St., N. Y.

Farley's Reference Directory of the Machinists, Iron, Steel, and Metal-Working trades of the United States. A. C. Farley & Co., Philadelphia, Pa.

Improved Tack Machinery, made by The Willets Man'f'g Co., can be seen in operation at their works, 57 Clifford St., Providence, R. I.

The Complete Practical Machinist, $2 50; the Pattern Maker's Assistant, $2.50; Mechanical Drawing Self-taught, $4 00; books for practical machinists. Address, Joshua Rose, Box 3,306, New York City.

Locomotive Engine Running. By Angus Sinclair. Price, $2. A handsome, interesting book. Just the thing for a holiday gift. Published by John Wiley & Sons, 15 Astor Place, N. Y.

EXTRACTS FROM CHORDAL'S LETTERS, 400 pages, 12mo., handsomely bound in cloth. New and enlarged edition, with over 50 illustrations. Price $2. Published by John Wiley & Sons, 15 Astor place, New York.

Useful Information for Steam Users—A 100-page pamphlet, on the care and management of the steam engine and boiler, with hints and rules for engineers and firemen. Every engineer should have this book. Send 25c. in P. O. stamps to the J. N. Mills Publishing Company, 145 Broadway, N. Y.

Manufactures.

A foundry is to be established in Charleston, W. Va.

Thomas H. Savery, Wilmington, Del., will build car works at Harper's Ferry, Va., in the Spring.

A. J. Williams, Jackson, Ga., is negotiating to establish a cotton seed oil mill at that place.

McCollum & Warrell have established a machine and boiler shop at Donaldsonville, La.

A company is being organized to establish a steam tannery at Trenton, Tenn.

Delbridge, Brooks & Fisher, Detroit, Mich., will erect a $6,000 brick factory on Warren Ave.

J. E. Scripps, Detroit, Mich., will erect a $5,000 factory at 316 Grande River Ave.

Several Holyoke (Mass) mills were obliged to shut down recently on account of the anchor ice.

The Rochester (N Y.) Machine Tool Works will bring out a new pillar shaper, 15″ stroke.

The Gale Manufacturing Company will rebuild on the old site at Albion, Mich.

Durkee & Keffer, of Chicago, are building an improved cotton-picking machine for use in the Southern cotton fields

Thomas Livingston, Kissimmee, Fla., is building a carriage factory, and Robert Bass, of the same place, will build a grist mill.

J. D. McNeely and T. P. Johnson, Salisbury, N. C., will establish a woolen mill; have purchased part of machinery.

Ground has been broken at Wampum, Pa., for a new wire mill; it will start up February 1. The buildings will be 250x90 and 250x45 feet.

There is a move at Newark, Ohio, to start up the old Blandy machine shops, which have been idle a number of years.

The Locomotive Improvement Company, Toledo, Ohio, will begin operations about the middle of January.

All the New Orleans cotton seed oil mills are running, and the prospects for a profitable year are more encouraging than they were last year.

Daniel Prosser, of New Albany, Ind., has been investigating the advantages of Paducah, Ky., for a rolling mill, and contemplates erecting one there.

Several large shops in Rockland, Mass., are to be remodeled into tenement houses, there being no business to keep them employed as heretofore.

A company has been incorporated in West Virginia by Boston capitalists, with a capital stock of $150,000 to manufacture paper slippers.

The Campbell Printing Press and Manufacturing Company, Chicago, will erect new shops next May, having 10,000 to 15,000 square feet of floor surface.

Ferdinand Munch will erect a brick brewery 84x62 feet, five stories high, at 285 Vernon Avenue, Brooklyn, N. Y. It will cost $60,000. The builder is John Auar, 442 South 5th Street.

Wm. T. Bate & Son will remove their boiler shops from Conshohocken, Pa., to Bridgeport, Pa They are building a shop 100x50 feet at the latter place, and will erect another of same size in the spring.

The Chicopee (Mass.) Falls Manufacturing Company are building a brick mill 400x90, four stories, with tower, which will increase their capacity nearly 100 per cent.

The Presumpscot Knitting Company are about to remove their works from Saccarappa, Me., to Broadalbin, N. Y., where, they state, taxes will be less and labor cheaper.

A company will be formed this winter for the purpose of establishing a water supply for Gardiner, Me. The plan is to take the water from the Cobbossee stream, pump it into a reservoir, and carry it by pipes all over the city and Farmingdale,

The Marshall Car Wheel and Foundry Works, Marshall, Texas, whose shops were recently burned and who are rebuilding, will soon build a large machine shop, and also fill one of the buildings now up with wood-working machinery.

The New Home Sewing Machine Company, at Orange, Mass., have reduced their running time to eight hours per day and four days per week; never before in its history has business compelled them to do this.

Frank T Ellis, of New York, has agreed to build a 100-ton blast furnace at Sheffield, Ala.; work to commence in 60 days. The site has been donated by the Sheffield Land, Iron and Coal Company, office, Tuscumbia, Ala.—*Baltimore Manufacturers' Record.*

The Alabama Great Southern Railroad Company, at a meeting in Birmingham, Ala., decided to increase their capital stock $1,000,000 for the purchase of steel rails. It is thought that a part of the money will be put into their proposed machine shops.

Commander Gorringe, of the American Shipbuilding Company, Philadelphia, has designed and constructed a pair of shears which have a lifting capacity of 150 tons, a swing of 30′ clear of the wharf on which they are located, and a lift of 86′ above mean tide.

The Stewart & Viernow Machine Company have erected new works in St. Louis, where they will build steam engines and machine tools. The building at 2705 N. Broadway is 70x37 feet. The works have been started and other new tools will be put in.

It is now regarded as quite probable that Augusta, Me., is to have a wire factory. It is ascertained that the stock can be placed and a plant purchased at a very low price. The furniture factory building, on the East side, would be used, and the machinery of the defunct Hallowell Wire Works transferred thereto.—*Mining and Industrial Gazette.*

Wilson & Roake, Dover and Water Streets, New York, are putting in an engine to run the ventilating machinery in the Standard Oil Company's new building on Broadway. The whole building is traversed with ventilating pipes, which draw the vitiated air out of each room, the current being induced by two blowers on the roof, which the Wilson & Roake engine operates.

The *Baltimore Manufacturers' Record* says: "C.W. Charl on, Knoxville, Tenn., is corresponding with different parties who contemplate the erection in that city of steel works, a planing mill, a cooperage factory, and an axe handle and tub factory, while O. G. Vanderhoof, of the same city, reports that a $25,000 tool factory will probably be established there."

Woodward & Rogers, formerly with Dwight Slate, have started a jobbing shop in Wood's building, Hartford, Conn., and will soon have ready for the market a nut-tapping fixture to go on any lathe or drill press, and several other specialties. They are practical machinists, and have had a wide experience. Mr. Woodward had charge of building torpedo boats for the Russian Government for three years, and Mr. Rogers has been a well-known contractor in Hartford for twenty years.

A correspondent of the Piscataquis *Observer*, writing from Milo, Maine., says that in the town is an abundant and reliable water-privilege situated on a stream that has so many large lakes and ponds as to render it almost impregnable to the severest drought. Not only can the lumber that lines the well-wooded shores be floated to the village, but the B. & K. I.W. Railroad, penetrating an unbroken forest, furnishes a cheap and efficient means of transportation. Yet with all these advantages there is not much manufacturing in Milo.

The Kensington Engine Works, Limited, Beach and Vienna Streets, Philadelphia, have recently furnished four engines for the Baldwin Locomotive Works; one to drive their electric light plant; one for their Willow Street shops, and the other two to be placed on the second and third floors of the new building put up on Hamilton Street in place of the one that was burned. These latter engines are self-contained, and when tried at the works before being delivered, were run to speed without being bolted down, merely being leveled up on wedges.

An Association has been formed under the name of the "Universal Mechanical Agency," for the purchase and shipping of machinery and all kinds of manufactured articles to any part of the country. M. Gonzalez Marron is the general agent, and Pablo Bonnerue, Alexandro Quijano, M. Pastor Valdes and Plutarco Rodriguez, agents in the City of Mexico, Peubla, Veracruz and Orizaba respectively. The agents undertake to furnish skilled machinists to attend the setting up of machinery when such help may be desired.—*Mexican Financier.*

The officers of the New Home Sewing Machine Company, at Orange, Mass., talk more encouragingly over the prospects of a revival of trade soon; they have no surplus stock of machines on hand, and a sudden boom of orders would necessitate a considerable increase in production. At the present time the New Home Company are giving more employment to their help than any other sewing machine concern in the country. The Rodney Hunt machine company also report increased orders, and the Chase Turbine Manufacturing Company continue to run on full time.—*Springfield Republican.*

The Glen Cove (L. I.) Manufacturing Company have ordered from Watts, Campbell & Company a pair of 28′x56″ condensing engines for their works, which they will put in early in the spring. They will keep their old engines in place as a reserve. At present, in addition to their large engine—600 horse-power—they use 160 horse-power, done by 35 separate cylinders. When the new engines are put in place they will drive this part of their work with wire ropes. A great deal of hot water is used in the manufacture of starch, and to provide this, the company's engineer, Mr. Grimm, devised a heater, which he used between the engine and condenser. This not only furnished the hot water, but made the work of the condenser and air pump so much lighter as to improve the vacuum by about two inches. He will construct a special heater to use between the new engines and condenser.

The Vandalia Railroad will erect extensive repair shops at South Bend, Ind. This road is a branch of the Terre Haute & Indianapolis. Geo. H. Prescott, Terre Haute, Ind., is Superintendent of Motive Power, and C. R. Peddle, of the same place, is purchasing agent.

The financial embarrassments of the Iron River (Mich) Furnace Company have been adjusted satisfactorily to the creditors, and the construction of the works will be energetically pushed to completion. It is hoped to have the furnace in operation by the first of next June.

John Cooper, weaver, has arrived at Providence, R. I., from Nottingham, England , bringing with him 140 employes of his factory in that city. Hard times forced him to abandon his business there, and he has come to try his fortunes and those of his people in starting a new factory at Providence, R. I. Protection seems to have more attraction for him than free trade.

The Knowles Loom Works have been incorporated at Worcester, Mass., with a capital of $300,000, for the manufacture and sale of looms and other machinery, with Francis B. Knowles, president; Frank P. Knowles, vice-president; Charles H. Hutchins, Treasurer; Henry H. Merriam, Secretary: George F. Hutchins, general superintendent, and John M. Russell, cashier. The loom works have heretofore been conducted by the firm of L. J. Knowles & Brother.

In New Orleans the machine shops, machinery dealers, and manufacturers generally are active. The oil mills are doing a large business, and the sugar refineries are busy. The cotton and sugar trades are lively. The city has been cleaned, painted, polished, and decorated generally for the reception, inspection and entertainment of the hundreds of thousands of visitors who will arrive during the next six months.—*Southern Industrial Record.*

Machinists' Supplies and Iron.

NEW YORK, January 1, 1885

Supply dealers express a hopeful view of future business prospects, although the demand has been very sluggish during the finishing months of the year Taking the year all through, a fair volume of business has been transacted, but the principal reason for complaint has been that the prices represented scarcely a living profit. A good many dealers who were on the downward grade sold goods recklessly below cost to obtain business, and this depressed prices for those who were doing a legitimate business. This source of disturbance is about dried up, and dealers think that early in the new year prices will rally.

Iron—Transactions in pig iron have been very limited during the week. This is the season when stocktaking is going on, so that purchases are naturally light. The tone of the market has been steady, and the feeling as to future prospects is more sanguine than it has been for several weeks. Standard North River and Lehigh brands are quoted $18 to $18.50; No. 1 X Foundry, $17 to $17.50, at tide water; No. 2 X, $16.50; Grey Forge, $15.50, at furnace. Outside brands are irregular in price.

Copper—The market for ingot remains in the same demoralized condition reported for several weeks. The pool which so long maintained prices by combination has lost its grasp on producers, and the prices in London are now regulating American quotations. Lake is quoted at 11 to 11¼ cents, and other brands 10¾ to 10⅞ cents

Lead—The market for common pig has ruled dull, with limited demand. Prices are unchanged, viz: 3.60 to 3.65 cents.

Tin—This market, like most of the others has ruled dull, with prices slightly easier than they were when last week's report was made. For jobbing lots Banca is quoted at 19 cents; Straits and Malacca, 16¾ to 16⅞ cents.

WANTED

"Situation and Help" Advertisements, 30 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Situation by a first-class pattern maker. Address E. O. H., 32 Cross st., Portland, Me.

First-class patternmaker is open for engagement January 1st, 1885. Address P. M., AM. MACHINIST.

Wanted—By competent boilermaker, situation as foreman; 2 years experience. Address Boilermaker, Postoffice, South St. Louis, Mo.

Wanted—A foreman to take charge of machine shop manufacturing stationary engines. Address Box 2, AM. MACHINIST, with references, and state where last employed and what salary expected.

Practical machinist and engineer wants position to travel West and South to sell steam users' specialties, engines, boilers, etc. At present manager of machinery agency. References unquestionable. Corresp'd'ce solicited. Address BOX 13, AM. MACH.

For Sale—Our Worthington duplex steam pump, nearly new, in perfect order, size 4½ x 2¾ x 4. Will be sold low if applied for soon. Address Wm. H. Clapp, Weymouth, Mass.

FOR SALE VERY LOW

BEFORE TAKING STOCK.

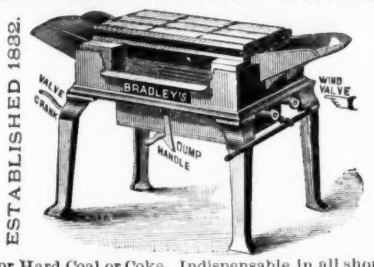
1 Iron-Frame Circular Saw Table for 14" Saw.
1 4" one-side Moulder.
1 16"x 6' Drill or Speed Lathe.
1 16"x 8' Pattern Maker's "
1 16"x 6' Drill Lathe with Milling Machine attached.
1 24" Stationary-head Upright Drill.

For full particulars call on or address

COOKE & CO.,
22 Cortlandt Street, N.Y.

BRADLEY'S HEATING FORGES.

ESTABLISHED 1832.



For Hard Coal or Coke. Indispensable in all shops to keep **Bradley's Cushioned Hammers** and men fully employed, and reduces cost of production.

BRADLEY & CO. Syracuse. N.Y.

DEAN BROS'
STEAM PUMP WORKS,
INDIANAPOLIS, IND.

Boiler Feeders, Fire Pumps, Pumping Machinery for all purposes.

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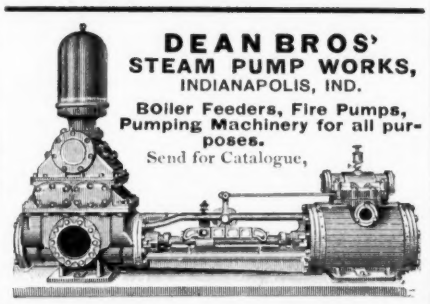

THE BROWN HAMMER
STRIKES A BLOW WITH
DOUBLE THE VELOCITY That it Raises the Hammer
A NEW MOVEMENT | SEND FOR DESCRIPTION.
KNOWLTON MFG. CO., King St., Rockford, Ill

STEPHENS PATENT VISES.

50 Per Cent. of time and labor saved by using this solid, strong, durable, quick-working Vise. Has the improved taper, pipe and other attachments. Sold by the trade. Send for circular.

MELVIN STEPHENS, Prop'r,
Office, 41 Dey St., New York.

The Fireman's Guide.
A Handbook on the
CARE OF BOILERS
By KARL P. DAHLSTROM, M. E.
Crown 8vo, Cloth, 50 Cents.
E. & F. N. SPON, 35 Murray St., New York.

DRAWING INSTRUMENTS.

Illustrated Catalogue of Drawing Instruments and Materials sent free on application to
WM. T. COMSTOCK, 6 Astor Place, N.Y.

JUST PUBLISHED!

New and Complete Illustrated Catalogue,

OF BLAKE'S — IMPROVED — STEAM

PUMPING MACHINERY.

SEND FOR A COPY.

Address, GEO. F. BLAKE MANUFACTURING COMPANY

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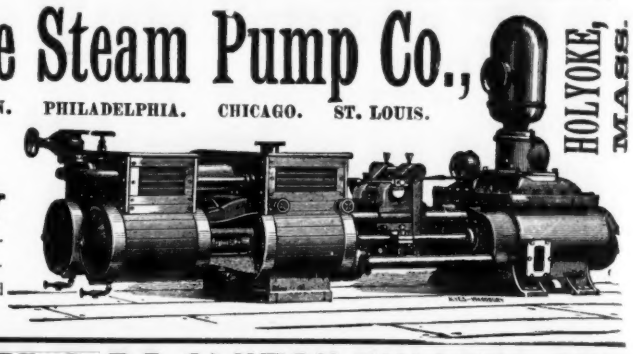
The Deane Steam Pump Co., HOLYOKE, MASS.

NEW YORK. BOSTON. PHILADELPHIA. CHICAGO. ST. LOUIS.

MANUFACTURE
PUMPING MACHINERY
FOR ALL DUTIES.

Send for New Illustrated Catalogue.



FRICTION CLUTCH PULLEYS AND CUT-OFF COUPLINGS.
JAS. HUNTER & SON, North Adams, Mass.

STANDARD TOOL CO., Cleveland, Ohio. { W. A. BABCOCK, Manager.

MILLING MACHINES.
SEND FOR DESCRIPTIVE CIRCULARS AND PRICES.
C.E. LIPE, Syracuse, N.Y.

FOR SALE AT A BARGAIN

A well established and good paying machine shop and foundry, including buildings, lots, machinery and stock. The business will be carried on until sold. Address

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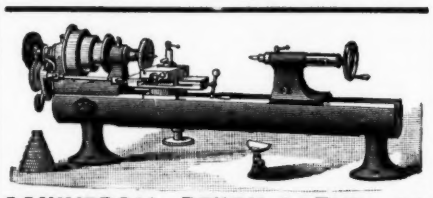

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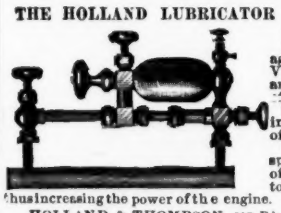

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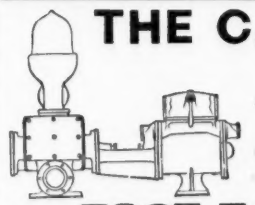

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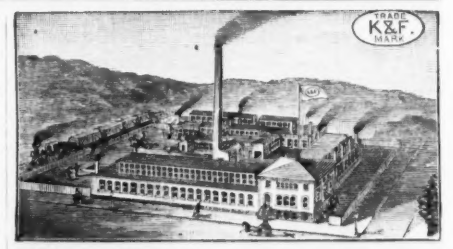

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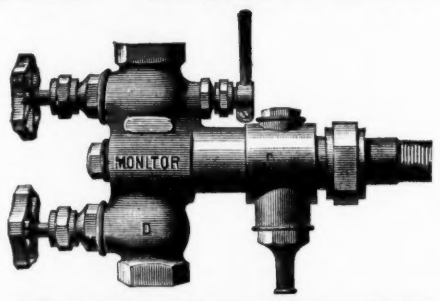

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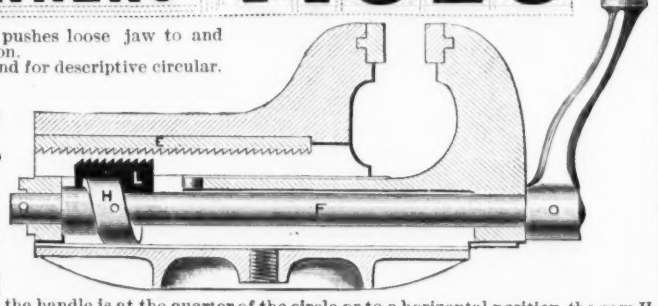

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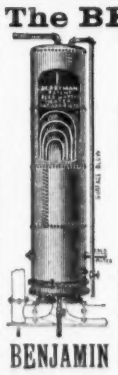

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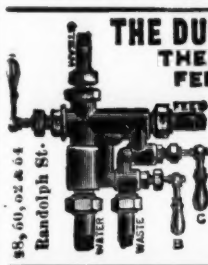

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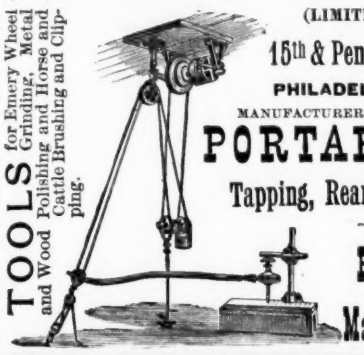

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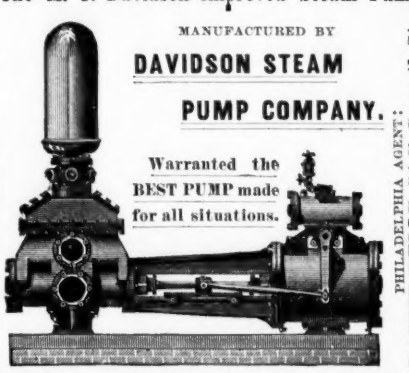

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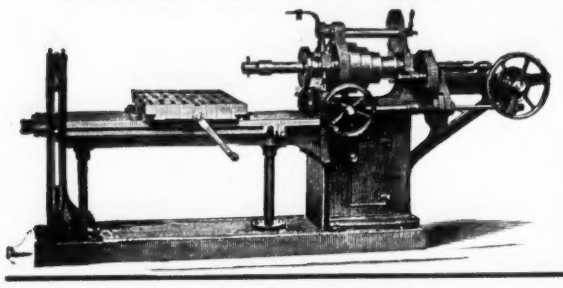

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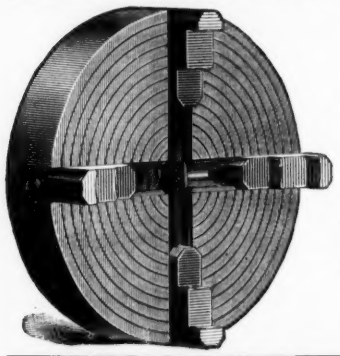

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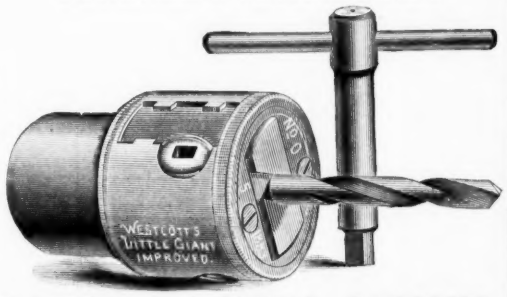

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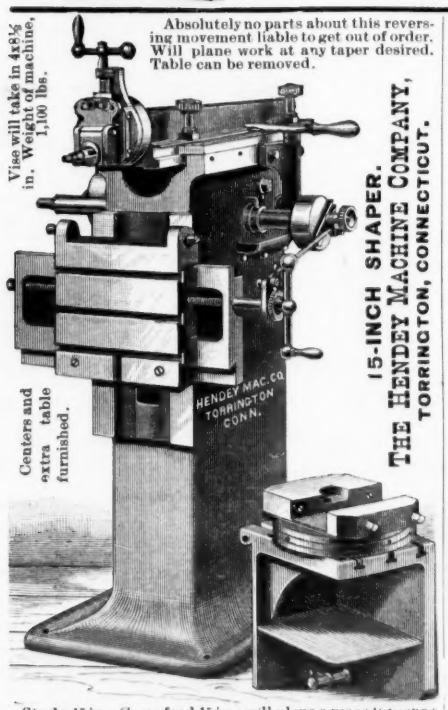

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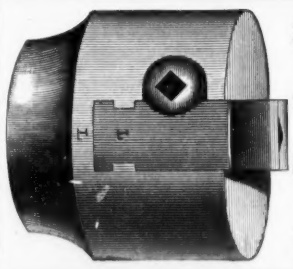

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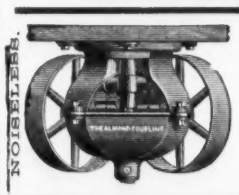

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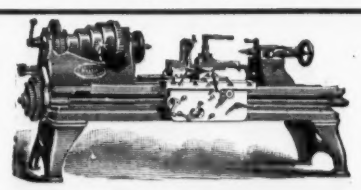

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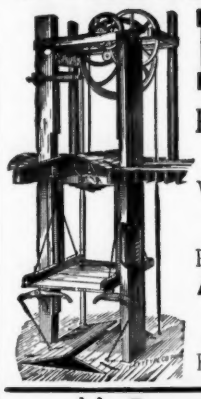

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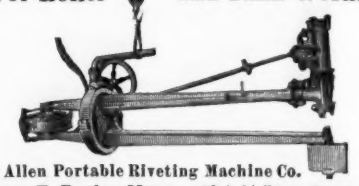

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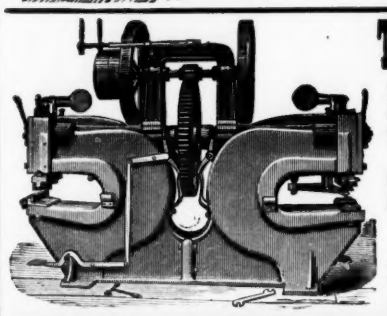

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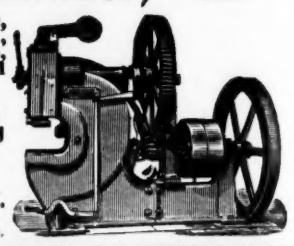

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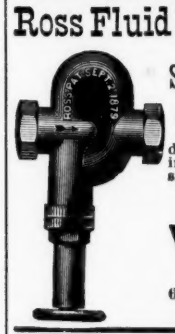

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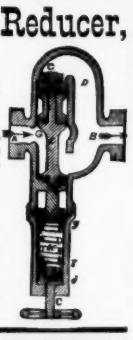

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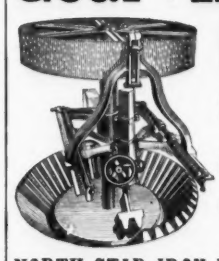

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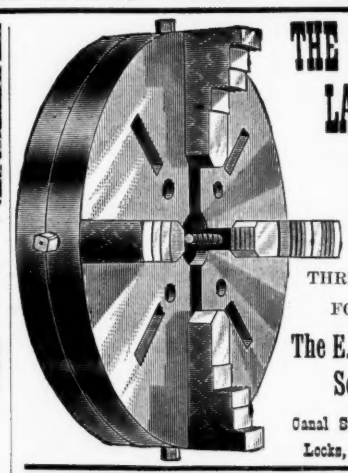

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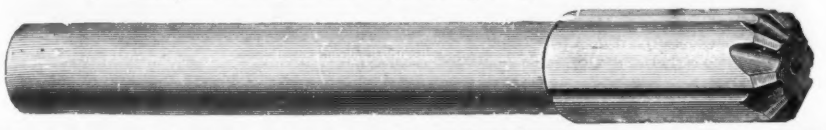

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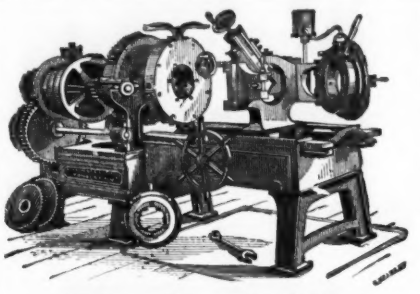

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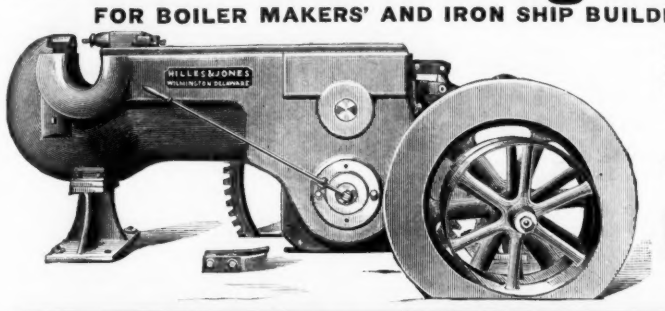

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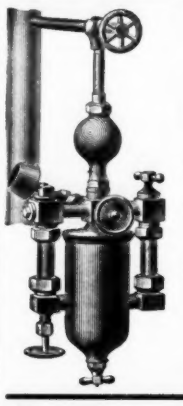

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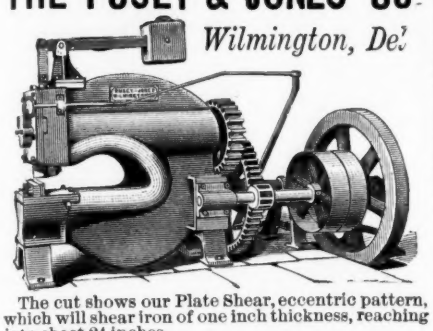

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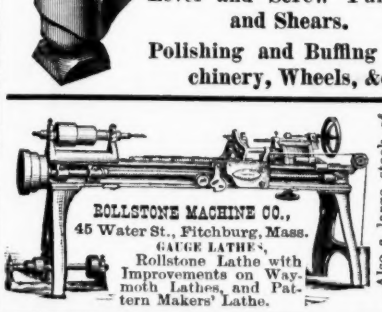

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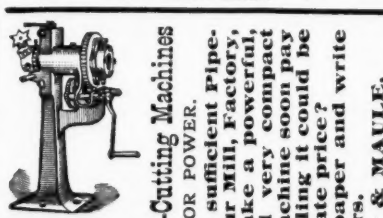

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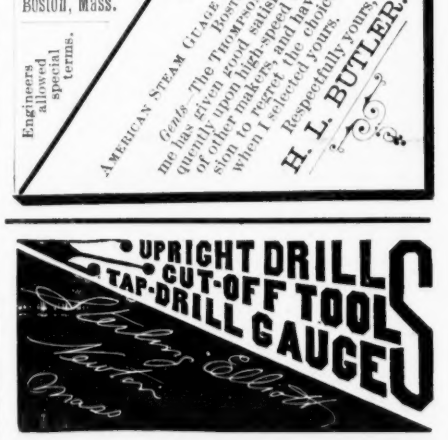

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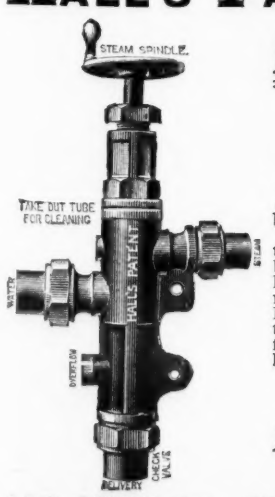

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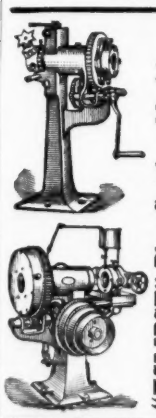

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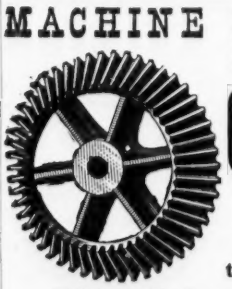

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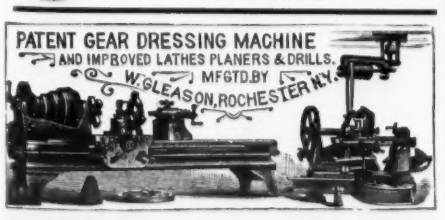

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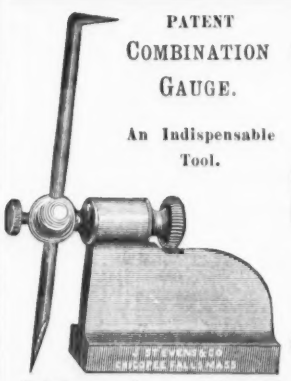

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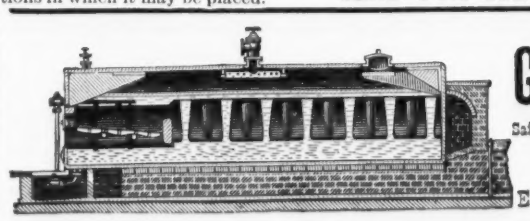

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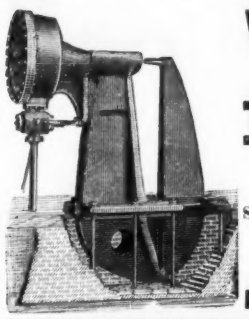

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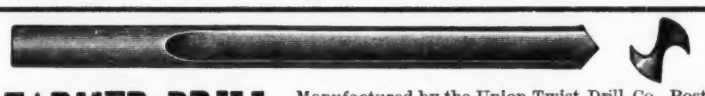

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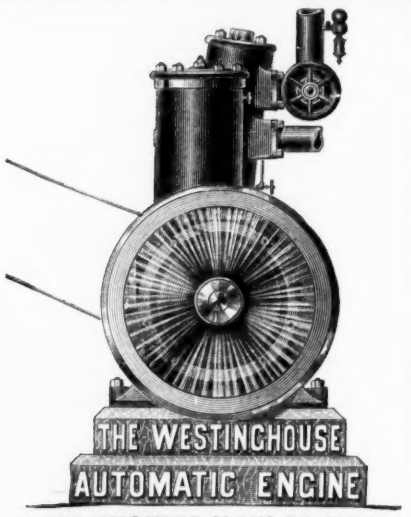

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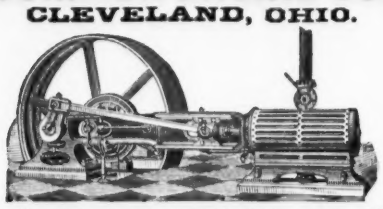

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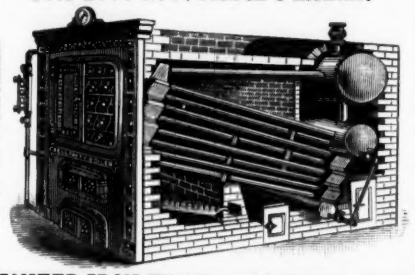

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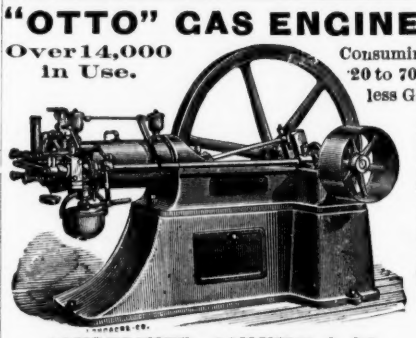

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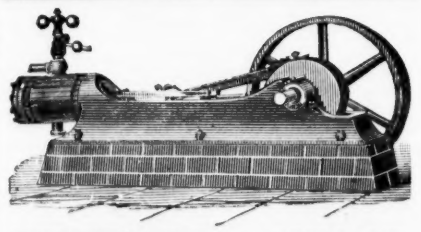

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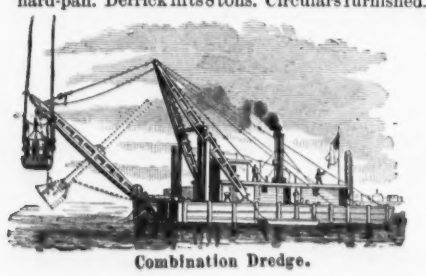

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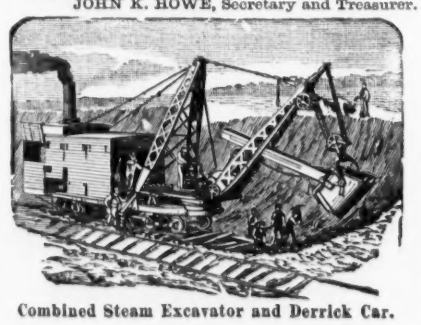

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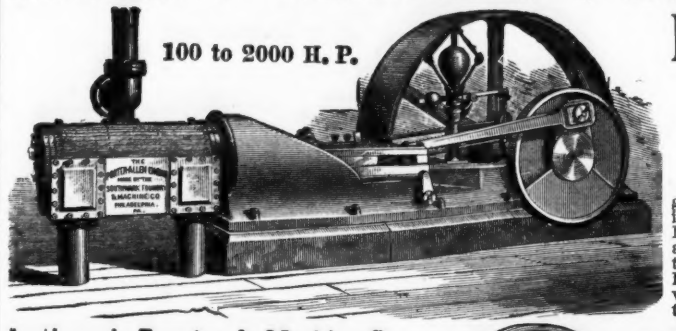

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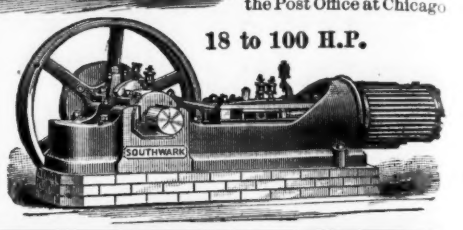

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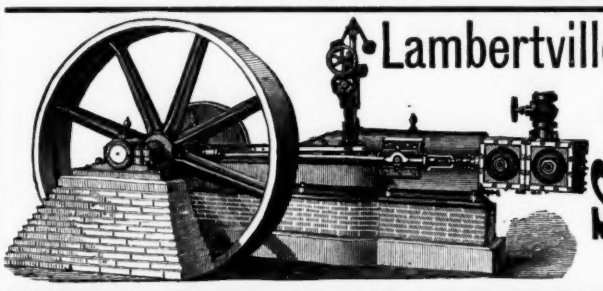

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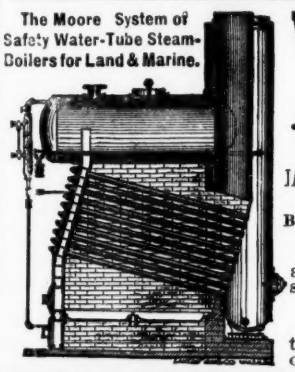

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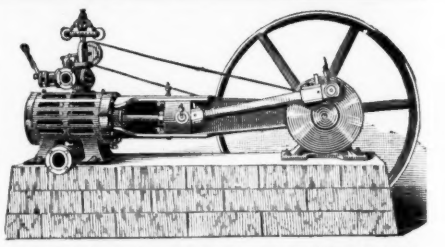

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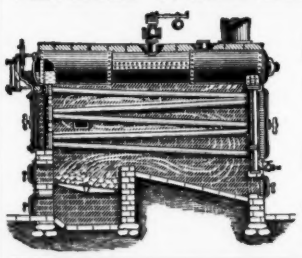

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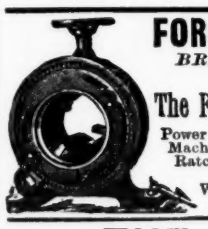

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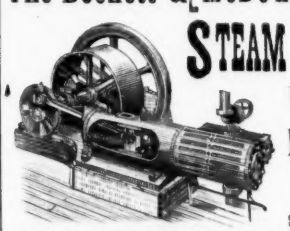

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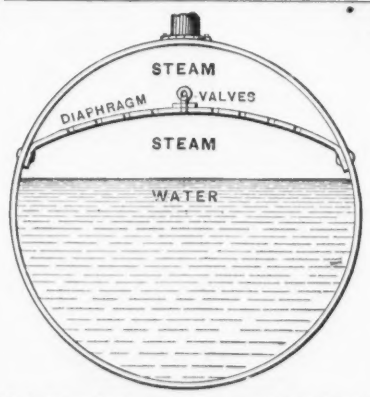

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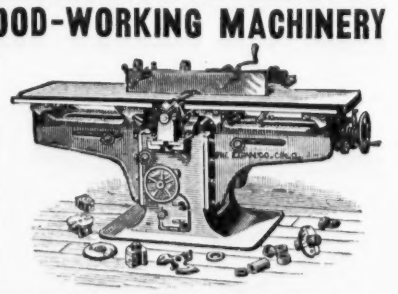

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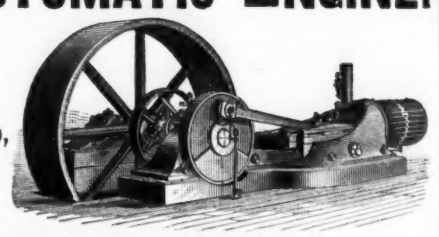

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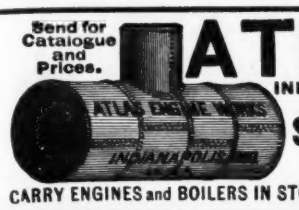

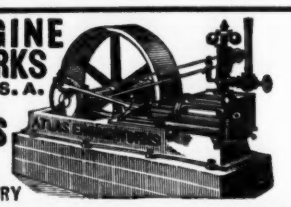

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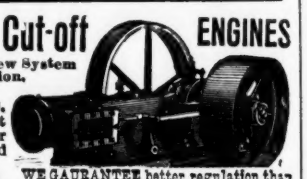

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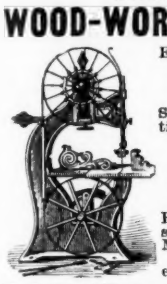

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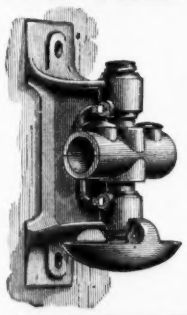

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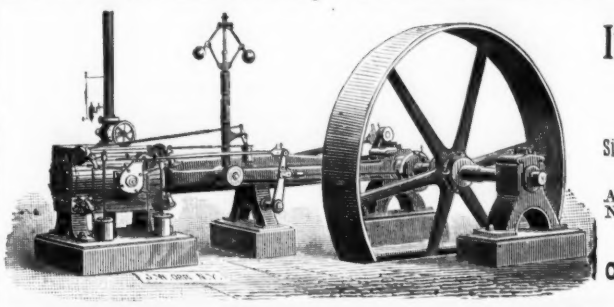

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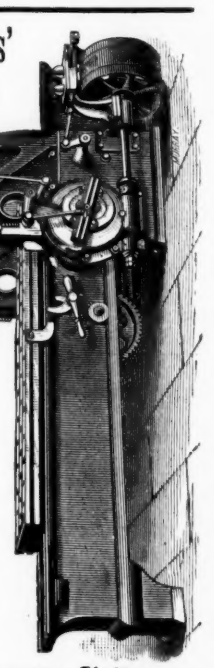

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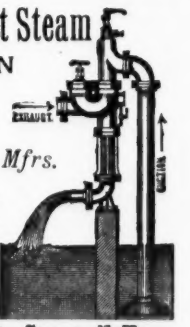

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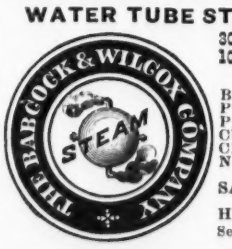

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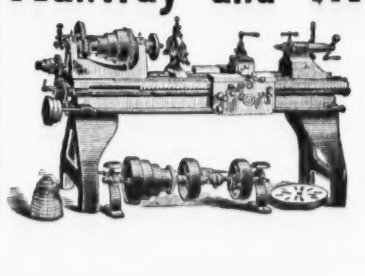

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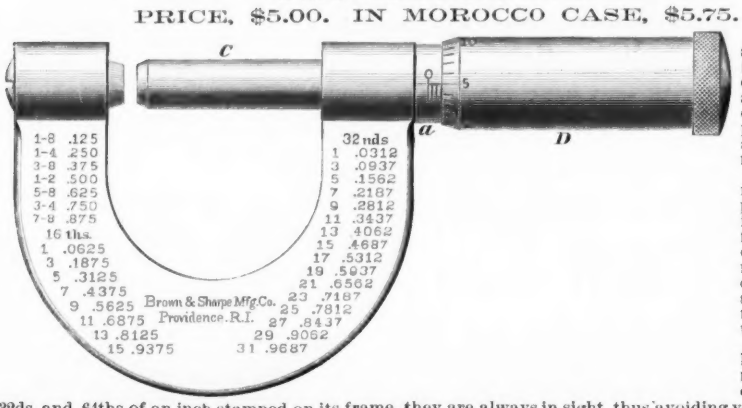

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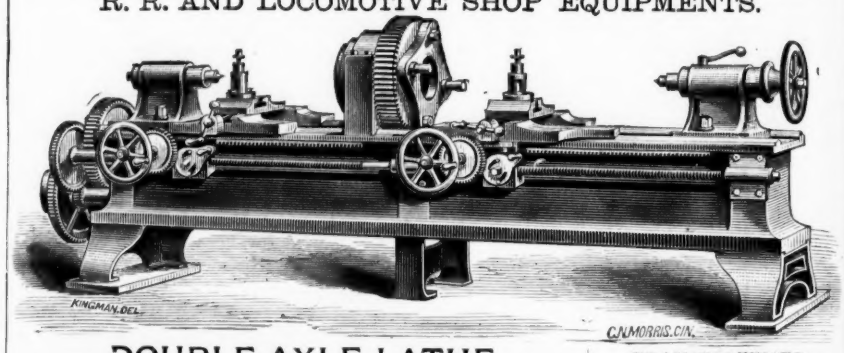

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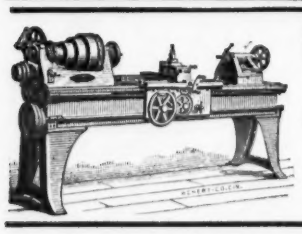

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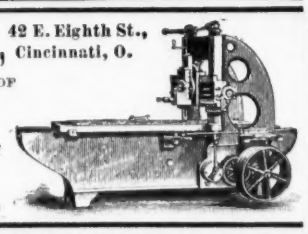

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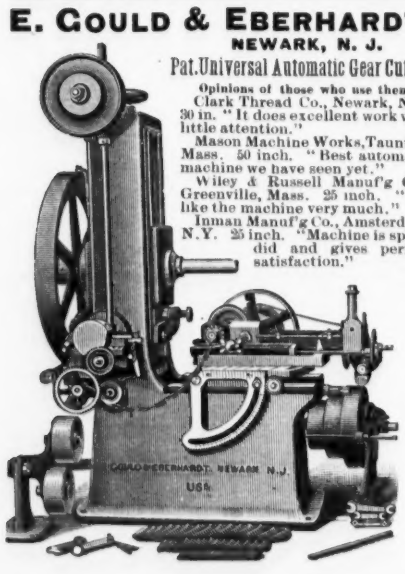

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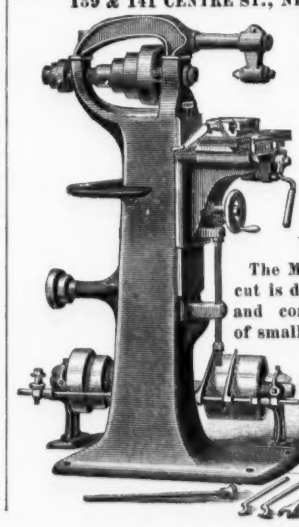

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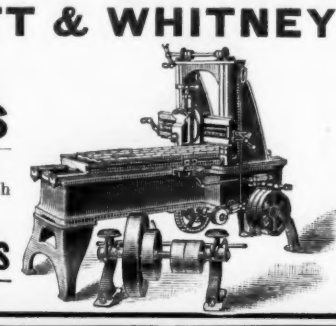

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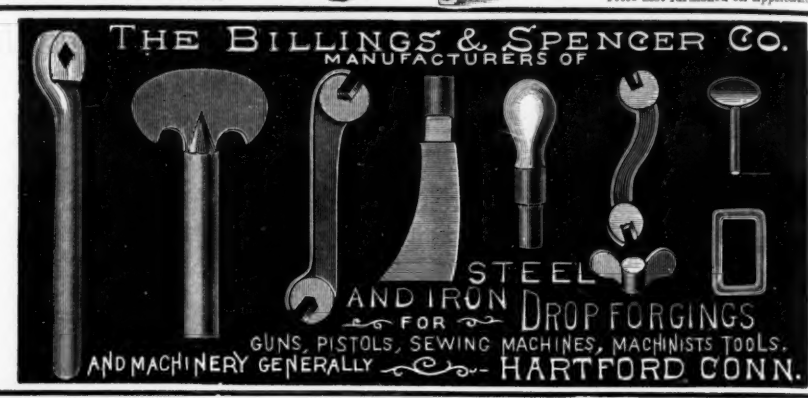

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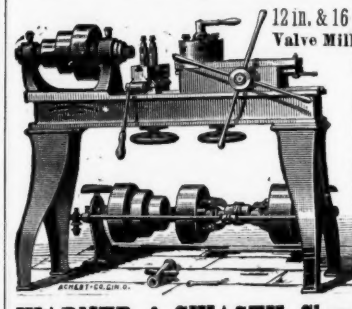

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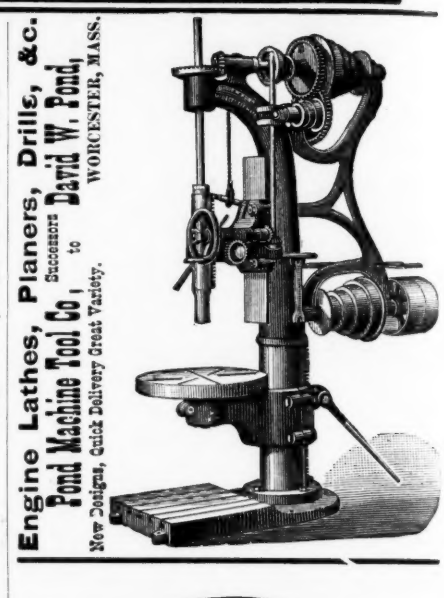

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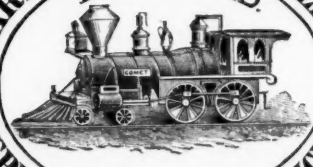

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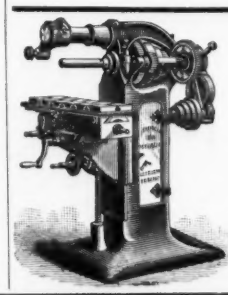

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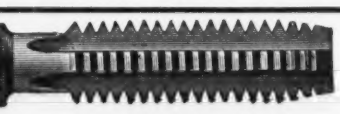

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